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by

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INTRODUCTION

The meat packing industry has been in a state of transition for the last three decades. Obsolete multispecies slaughter plants located near, and sometimes within, large metropolitan centers, have been shut down in favor of modern, new plants located in rural areas where livestock are abundant and relatively inexpensive to procure. Technological innovations in plant design and equipment as well as specialization in single-species processing activities have dramatically increased the industry's productivity and efficiency.

Since beef packing has become a viable dynamic industry, in which internal change is the rule rather than the exception, practically every beef-producing region in the nation has been and is being affected. The impact on New York State and the northeastern region has been predictable. Since 1950, older plants, built at the turn of the century, have undergone substantial changes. Many plants closed entirely while others modernized and reopened as specialized slaughterers. The most prevelent species and classes these plants focused on were cull dairy cows and calves, the major forms of red meats from the region. Plants utilizing fed beef animals have contracted over the same period as the nearby terminal stockyards on which they depended for a supply of slaughter animals began a steady decline, compelling these plants to go outside the region for live animals.

One of the principal factors contributing to the low levels of fed cattle production in the Northeast has been the higher cost of transporting feed grains into this deficit grain production region compared to finishing cattle in feedlots within the principal grain producing areas of the country. Recently, however, animal scientists in the Northeast have begun investigating production opportunities associated with feeding out locally available

cattle on high forage diets with feedstuffs that are produced locally. If these investigations prove that such cattle feeding programs are economically feasible, then it may be possible to substantially improve the Northeast region's ability to produce fed cattle in the future.

Objectives

This study was undertaken to evaluate the adequacy of existing regional packers as outlets for Northeastern-produced cattle and calves, with special emphasis on fed cattle. An important aspect of this research involves analyzing the potential need for expanding regional cattle-slaughter capacity through the upgrading of existing plants and through the construction of new packing plant facilities. This study was conducted as an adjunct to an overall analysis of the economic potential for expanding feeder calf and fed beef production in the Northeast (for a summary, see Lesser et al.).

Historical Aspects of the Northeast's Cattle Slaughter Capacity Prior to and After the Wholesome Meat Act of 1967

A review of historical data indicates that in 1950 there were 79 federally inspected cattle slaughtering establishments in the Northeast[1/], with 21 of these plants being located within New York State. By 1970, the aggregate total of federally inspected plants had risen to 86, but only New York and Pennsylvania shared in this expansion of slaughter capacity. The six states within New England as well as New Jersey experienced significant declines during this same 20 year period. The New England states lost six slaughter plants while New Jersey lost eight federally inspected establishments. (Table 1)

However, by January 25, 1971, another 805 livestock slaughter plants also located in the Northeast had gained certification as state-inspected establishments with "at least equal to" inspection status to the existing 86 federally inspected slaughter facilities. This event was brought about by the enactment of the Federal Wholesome Meat Act of 1967. The federal act required that all nonfederally inspected meat packing plants throughout the country should be provided with state inspection service comparable to that of the federal government. It meant that packers doing business within their own state had to have their livestock inspected by state personnel before, during and after slaughter and that sanitary plant standards at least equal to federal requirements had to be provided. The purpose of the Act was to assure consumers of a sanitary, wholesome meat supply entering intrastate trade. The Federal Meat Inspection Program, enacted into law back in 1906, was designed to assure the wholesomeness of all meat products entering interstate and foreign trade.

1/ In this study, the Northeast region constitutes the six New England states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island as well as the states of New York, New Jersey and Pennsylvania.

TABLE 1.--Number of federally inspected meat establishments by region and states in the Northeast, 1950-80[1/].

Area	1950	1960	1970[4/]	1980[5/]
	(No. of plants)	(No. of plants)	(No. of plants)	(No. of plants)
New England[2/]	19	12	13 (+145 = 158)	42
New York	21	26	36 (+103 = 139)	90
New Jersey	19	21	11 (+47 = 58)	21
Pennsylvania	20	25	26 (+510 = 536)	264
Total Northeast[3/]	79	84	86 (+805 = 891)	417

1/ Data from 1950 through 1970 were obtained from unpublished sources at the Food Safety and Quality Service, USDA. Source: Most of the slaughter plants listed for those years represent multi-specie kill operations. Both "slaughter only" and "slaughter and processing" plants were included, while those "processing only" were deleted from the totals. Data for 1980 were obtained through a special survey conducted in 1980-81. Plants that "processed only" as well as those plants that slaughtered hogs only or sheep only, or both were deleted from the totals. Non-commercial state institutions with federal slaughter plant approval were also deleted.

2/ Includes the states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

3/ The region referred to in this study as the Northeast is officially listed in the Agricultural Statistics yearbook as the North Atlantic division.

4/ The Federal Wholesome Meat Act of 1967 required that by 1970 all nonfederally inspected meat packing plants throughout the country should be provided with State inspection service comparable to that of the Federal Government. Those data within brackets represent the number of state inspected slaughter plants that were granted "equal to status" with federally inspected plants. The last figure within each bracket on each line represents the total for federal and state inspected plants combined.

5/ As of 1980, six states in the Northeast eliminated their state inspection programs. These state inspection programs ended on the following dates: Connecticut 10-01-75; Massachusetts 1-12-76; New Hampshire 8-07-78; New York 7-16-75; New Jersey 7-01-75; and Pennsylvania 7-17-72. State meat inspection programs with "equal to status" to federally inspected plants still exist in the states of Maine, Rhode Island and Vermont, but almost all of these state inspected plants either slaughter poultry or just process red meat rather than slaughter livestock. Although the Federal Government has assumed responsibility for meat inspection in the absence of an approved state program, this does not entitle packers in these six states to make interstate shipments unless they specifically apply for and receive approval as a regular federally inspected plant.

While many states had established inspection programs of their own prior to the 1967 federal Act's enforcement deadline of 1970 (subsequently extended), there were previously no uniform standards of inspection to adhere to on a national basis. New York State initiated its own inspection program in 1963 when 168 slaughterhouses were recommended for licensing by the Commissioner of Agriculture. However, after New York State's meat inspection program was certified as being equal to that of the federal government on December 17, 1970, only 103 slaughterers received such certification. The required higher facility standards and the capital expenditures necessary to meet those standards apparently removed a number of marginal firms from the marketplace. Others may have chosen to close their doors for other reasons, but the net effect of the Act was to upgrade the remaining New York State inspected facilities. Similar declines in overall slaughter plant capacity were observed in the other state inspection programs in the Northeast well after the Wholesome Meat Act of 1967 became law.

During the ensuing 10 year period from 1970 to 1980, the number of federally inspected slaughter establishments increased dramatically since six of the nine Northeastern states elected to discontinue their state inspection programs. In almost all cases, the primary reason for withdrawal of these state inspection services was budgetary considerations. Immediately thereafter, as each state discontinued its inspection program, the federal government stepped in to assume these meat inspection responsibilities. Consequently, the total number of slaughter plants for all species operating under federal inspection in the Northeast rose from a 1970 total of 86 to 417 by 1980, for a net increase of 385 percent. Actually, however, a close examination of these data reveal that there was a net loss in plant numbers of more than 53 percent when the number of both state and federally approved

slaughter facilities in existence at the beginning of 1971 are considered. The implications of this formidable change of events are that when tighter controls and higher facility and equipment standards were placed by the federal inspection program on plants formerly approved by the state, a further dropout of relatively marginal firms took place, since more capital was needed to further upgrade these packer facilities from the conditions required in 1971. Previous studies indicate that the advanced age of many plant owners combined with high interest rates and low profit margins discouraged them from borrowing capital to finance the necessary improvements to comply with the more stringent federal standards.[2/] (Stinson et al., Tomeo)

It should be noted that field surveys revealed that many of the smaller slaughter plants that did make the necessary improvements, and that have now received federal certification, are operated as vertically integrated businesses. In many instances, most of the owner's profits are derived from other segments of the enterprise, such as direct retailing activities, rather than slaughter itself. This enables many to remain in business even though their per-unit kill costs are noncompetitive relative to high-volume plants that benefit from economies of scale. Therefore, it can be assumed that a substantial further decline in existing kill-capacity attributed to aggregate small-operator activity in the Northeast will not necessarily occur, even though such small firms continue to remain noncompetitive from a kill-cost perspective. One might conclude instead that those owners leaving the industry, for whatever reason, will be able to sell their slaughter facilities as viable business entities, thereby generally maintaining the existing

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2/ (Note: While these circumstances depict events that occurred during the initial reaction to the Wholesome Meat Act of 1967, they are also illustrative of similar events that took place after six Northeastern states withdrew their state meat inspection programs during the 1970s)

amount of regional kill-capacity attributed to operators belonging to this small size category of the industry.

A survey of several existing packers in New York and Pennsylvania during the winter of 1981 confirmed these basic conclusions, which can be assumed to be applicable to the remaining seven states within the northeastern region. The survey was conducted on a stratified, random sample basis and therefore enabled the team of researchers to view all types of operational activities being conducted in the Northeast. The physical condition of cattle slaughter plants currently operating in New York and Pennsylvania is basically good, although improvements in additional labor-saving equipment could improve their existing levels of productivity in several cases.

In addition to the above listing of commercial livestock slaughter plants currently in operation, there were 211 inspection-exempt plants operating in the Northeast as of 1980. Inspection-exempt plants are defined as those approved by a local health service arm of state government for the custom slaughter of livestock and game, whose meat will be held for the exclusive use of the owner, members of his household, and non-paying guests. Unfortunately, this number of inspection-exempt plants also includes those slaughterers who still remain under state inspection in Maine, Rhode Island, and Vermont. A more definitive breakdown identifying these state inspected plants was unavailable.

AVAILABILITY OF SLAUGHTER CATTLE AND CALVES IN THE NORTHEAST

Two principal data sources exist for determining regional cattle supplies. The first source is reports on slaughter by state, and by species and class as recorded by the Packers and Stockyards Administration and by the Crop Reporting Board. These data, however, record volume by state of slaughter, not origin, so that with limited data on interstate shipments, regional slaughter statistics are inadequate for determining local supplies. The second data source is the Crop Reporting Board's farm inventories by specie and class. Combined with data series on dispositions, the farm inventory estimates may be used to determine the available supplies of slaughter animals in the region.

Estimated Annual Cattle-Slaughter Potential from Existing Regional Herds

Crop Reporting Board data allow an estimate of the total annual cattle and calves marketed or otherwise disposed of in New York and the Northeast (Table 2). The major animal classes and uses included under the marketing category are as follows:

(1) cull cattle going directly to slaughter consisting of cows culled from both the dairy and beef herds as well as smaller numbers of bulls and stags from the same sources;

(2) cattle custom-slaughtered in commercial plants for use on farms where the livestock were produced;

(3) cattle locally fed-out to slaughter weight on either grain rations, forage feedstuffs, or some combination of both; and

(4) the remainder that is left after the above livestock disappearance categories have been accounted for from reported region-wide cattle marketings. This residual represents an estimate of the number of cattle being

TABLE 2.--Annual inventory, supply, and disposition of cattle and calves in New York State and the Northeast region, 1950-80[1/].

Area and year	Beginning January 1, inventory	Calf crop	Inshipments[2/]	Marketings[3/]		Farm slaughter[4/]	Deaths		Ending December 31, inventory
				Cattle	Calves	Cattle & Calves	Cattle	Calves	
	--- thousand head ---								
New York State									
1950	2,116	1,210	27	327	672	35	40	163	2,116
1955	2,311	1,328	19	347	852	29	40	125	2,265
1960	2,131	1,212	28	294	766	25	35	99	2,152
1965	2,026	1,147	22	340	758	22	36	94	1,945
1970	1,799	975	33	303	605	10	23	84	1,782
1975	1,875	975	24	276	509	21	33	120	1,915
1980	1,780	950	22	226	517	9	33	116	1,831
	--- thousand head ---								
Northeast Region									
1950	5,173	2,796	215	938	1,570	120	92	290	5,174
1955	5,694	3,070	197	1,009	1,906	112	90	263	5,581
1960	5,285	2,824	254	923	1,675	90	83	229	5,363
1965	4,985	2,626	226	1,050	1,622	85	81	222	4,777
1970	4,497	2,305	206	902	1,363	41	63	190	4,450
1975	4,726	2,232	153	898	1,055	50	132	254	4,772
1980	4,587	2,189	161	795	1,023	43	87	251	4,738

1/ Meat Animals: Production, Disposition, and Income, 1950-80, Mt. An. 1-1 series, Crop Reporting Board, ESS, U. S. Department of Agriculture, Washington, DC.

Special note: The sum of January 1, inventories, the calf crop, and inshipments is equal to the sum of the marketings, farm slaughter, herd death losses, and December 31 inventories.

2/ Livestock shipped into state or region for feeding or breeding. Excludes livestock inshipments for immediate slaughter.
3/ Includes animals for slaughter as well as livestock shipped to other states for feeding and breeding purposes. Excludes interfarm sales within state and farm slaughter, but includes custom slaughter in commercial plants for use on farms where livestock are produced.
4/ Animals slaughtered on farms. Excludes custom slaughter for farmers at commercial establishments.

shipped out of the region for feeding or breeding purposes. The approximate number of animals in each group in 1980 can be estimated as follows.

Cull Supplies

The basis for estimating the annual replacement or culling rates can be developed by applying average marketing rates in the Northest region to local dairy and beef herd populations (Haas et al., Van Arsdall and Skold). In particular, estimates of cull cows and bulls available for slaughter are calculated by applying the following rates to the inventory herd data appearing in Table 2. Annual beef cow replacements represent 14 percent of the region's existing beef cow herds; beef bull replacements are equal to 1 percent of the beef bull herd; milk cow replacements are equivalent to 21 percent of the dairy cow herds; and dairy bull replacements, although equal to less than 1 percent of that herd, can be rounded up to 1 percent to simplify the calculations. Since death loss considerations have already been integrated into theabove estimates, these data may be applied directly to farm inventories of cows and bulls. Based on these procedures, it was determined that aggregate culling activites from the Northeast's herds during 1980 would have yielded 48,300 beef cows; 427,770 dairy cows; and 750 bulls and stags for a grand total of 476,820 head of cull cattle.

Farm Slaughter

Through the assistance of Crop Reporting Service officials stationed in Albany, New York (and elsewhere), the following bench-mark observations were made based on reviews of historical data and reports originating from New York and other Northeastern states. The custom-slaughter of cattle for farmers in commercial plants is estimated to be at least equal to the level of cattle slaughtered on farms for home use. Such an estimate must be

viewed as conservative. The actual number of custom-slaughtered cattle for farmers may be higher. Since the farm slaugher statistics cited in Table 2 are a composite of cattle and calf slaughter, the acutal number of cattle attributed to farm slaughter was probably about three-quarters or more of the 43,000 head reported in the Northeast region during 1980, with the remainder being calves slaughtered at weights under 500 pounds. Consequently, for purposes of estimating marketing category eliminations for 1980, an estimate of 43,000 head of cattle custom-slaughtered in commercial plants for farm use would have to be viewed as a minimal figure.

Regional Cattle Feeding

Data obtained from the U.S. Crop Reporting Board's Cattle on Feed series indicate that as of January 1, 1980, feedlots in the Northeast region contained inventories of 92,000 head of cattle on feed. These feedlot inventories were broken down into states as follows: Pennsylvania 79,000 head; New York 8,000 head; New Jersey 2,000 head; and the six New England states 3,000 head. Since the annual turnover rate for Northeastern feedlots was 1.1139 during 1980, this means that a grand total of 102,479 head of livestock were marketed as fed-cattle from regional feedlots that year.

Estimates of forage-feeding activities on a region-wide basis were obtained through interviews with animal husbandry personnel at Cornell University and with members of the Statistical Reporting Service. In proportion to the reported marketings of fed-cattle from Northeastern feedlots during 1980, it was estimated that a total of 5,124 head of cattle were fed-out on mainly forage feedstuffs and marketed as slaughter cattle that year. This estimate represents about five percent of the total number of 102,479

grain-fed cattle that were marketed within the northeastern region during 1980.

Interregional Exchanges

The residual, or 167,577 head of cattle, left after the annual slaughter potential for all classes of cattle have been determined and accounted for, represents an overall estimate of cattle that were shipped out of state for feeding or breeding puposes. However, since region-wide inshipments of cattle for feeding or breeding purposes were estimated at 161,000 head during 1980, the net deficit of live-cattle leaving the nine-state region for feeding or breeding purposes amounted to 6,577 cattle for the year (Table 2).

Estimates of Fed Cattle Availability

A summarization of these findings reveals that of the total 795,000 head of cattle estimated to have been marketed from northeastern herds during 1980, 627,423 head of cattle went directly to packinghouses for slaughter. And since 476,820 head of these cattle were cull animals, the estimated number of grain-fed and forage-fed cattle available for slaughter from Northeastern herds over the full 12 month period in 1980 amounted to 150,603 head of cattle. Using similar procedures, New York's 1980 fed cattle availability for commercial markets was calculated to be 18,357 head. These estimates are based on the assumption that almost all of the custom-slaughtered cattle for farmers were fed and that they were recorded among the fed cattle available for slaughter that year, even though a transfer of ownership did not take place. If farmers sometimes ate non-fed cattle and if the production and slaughter statistics excluded the output from the numerous small herds throughout the region, then actual availability is underestimated here.

Future Availability of Slaughter Cattle

A detailed projection of cattle supplies five to ten years into the future is an involved task which goes beyond the scope of the present study. Nevertheless, some concept of anticipated supplies is necessary to understanding slaughter capacity requirements in coming years. The available evidence is reviewed here with emphasis placed on dairy herds as the major regional source of cattle. For example, in 1980, of a total January 1 inventory of 997,000 cows, 912,000 or 91.5 percent were dairy breeds and the remainder beef breeds (N. Y. Crop Reporting Service).

During the three decades from 1950 to 1980, the milking herd in the Northeast declined by over one million head, or almost exactly half of the 2.036 million head on regional farms in 1980 (USDA Ag. Stats.). Thus, on average, dairy herds have been declining by one percent per year. Much of this decline may be attributed to increases in production per cow, as aggregate milk supplies changed very little over the period. If this trend of greater output per cow and fewer cows continues, regional herds will shrink further in future years, releasing additional packing plant capacity.

Current trends suggest that past experience may underestimate regional dairy cow declines in future years. Perhaps the most important of these factors is the rate of genetic improvement. Until recently, improvements have come about largely through selective breeding, facilitated by artificial insemination. Much greater improvements and more rapid dissemination are made possible by embryo transplants, among other advances. Some animal scientists look ahead to the time when a Holstein will be as large as an Indian elephant and produce 45,000 pounds of milk a year, three times the current average (Business Week). While such major changes are probably

distant, an accelerated rate of improvement in breeding is likely within the next decade. Unless the demand for milk expands, which would require a reversal of past trends, herd numbers will also decline.

A second factor is a reduction in the profitability of dairying, brought about by changes in support prices. The initial response following the suspension of the biannual adjustment in parity prices for milk has been an increase in Northeast dairy herd sizes, the first seen in many years. Economists generally recognize this as a short term response to maintaining gross incomes during a period of low grain prices. In the longer term, it is widely expected that lower prices will force a number of dairy operations out of business, leading to a contraction in numbers of cows. Further milk price declines can be expected in 1983 if attempts to drastically cut budget allocations for daity price supports from the $2 billion level of the last several years are successful. To the extent that milk prices fail to rise (or even fall) in future years, cow numbers in the Northeast will likely decline more rapidly than the average for 1950 - 1980.

To an extent, reduced dairying favors beef production in the region. Both productive and mamgement resources released from milking would be best suited to cattle production. However, previous analysis has shown beef production to be less profitable in the Northeast than dairying (see e.g. Fox and Nowak, and Milligan et al.). Hence, while beef production may absorb some of the idied resources, a one-to-one substitution of meat for milk production is highly unlikely.

The basic conclusion of this admittedly cursory analysis is that Northeastern cattle herd sizes will decline over the coming decade, although the

actual rate of decline remains uncertain. For the regional packing industry, excess capacity will result unless there are further plant closings and/or importations of additional animals.

EVALUATION OF CATTLE AND CALF SLAUGHTER CAPACITY IN THE NORTHEAST

Within recent memory, two large (by regional standards) fed beef packing plants have closed in New York and Pennsylvania, and numerous others specializing in cull cows have ceased operating. Industry observers with a longer perspective in the region recall the time when several national firms operated packing plants in the Northeast. These are specific examples of a general decline in regional cattle slaughter best documented by annual figures. In New York, cattle slaughter declined by 50 percent from 1950 - 1980, while in the Northeast the number was down by nearly 600,000 (Table 3).

The reasons for the industry's decline in the Northeast appear to be three-fold. First and foremost was the gradual phasing out of the old terminal stockyards situated near large metropolitan centers in the region. This industry transition actually began well before the 1950s. As livestock receipts at the terminals steadily dwindled, old, obsolete packing plants with huge killing capacities that depended upon the terminals for their raw material procurements began to shut down one after the other. Livestock which had been shipped into the region by rail and truck for immediate slaughter was now being intercepted by packers that had strategically located new plants in high-density feedlot areas throughout the midwest.

While this single event, which changed the way in which the packing industry processed and marketed meat, probably had the greatest impact on curtailing beef production in the Northeast, there were two other factors that also contributed to the reversal in the fortunes of Northeastern packers. These were: (1) the documented long-term decline in the Northeast's own farm inventories of cattle and calves and consequently in the number of

TABLE 3 --Annual commercial slaughter of all cattle and calves by class in New York and the Northeast region, 1950-80[1/].

Area and year	Cattle	Calves	All cattle and calves
	--- Thousand head ---		
New York State			
1950	507.3	1,044.0	1,551.3
1955	632.0	1,143.0	1,775.0
1960	465.5	911.0	1,376.5
1965	444.0	929.0	1,373.0
1970	373.0	732.5	1,105.5
1975	368.2	893.0	1,261.2
1980	241.5	578.1	819.6
	--- Thousand head ---		
Northeast Region			
1950	1,712.5	2,573.0	4,285.5
1955	2,112.6	2,790.9	4,903.5
1960	1,933.9	2,298.1	4,232.0
1965	1,971.4	2,307.5	4,278.9
1970	1,609.0	1,683.1	3,292.1
1975	1,720.6	1,724.2	3,444.8
1980	1,177.6	1,083.8	2,261.4

1/ Agricultural Statistics, 1951-80, U.S. Department of Agriculture, Washington, DC. Data include slaughter in federally inspected and other slaughter plants, including state inspected plants; exclude animals slaughtered on farms.

animals from these regional herds available to be marketed for immediate slaughter, and (2) the relatively recent and dramatic increase in the price of fossil fuel, which impacted significantly on the cost of shipping livestock from states outside the Northeast to packers located within the region.

Nevertheless, packing plant activity in the Northeastern region today cannot simply be dismissed and categorized as grossly inadequate, particularly in view of the level of current supplies of cattle and calves that are available for immediate slaughter from regional herds and from herds of neighbouring states.

Slaughter Capacity and Utilization of Existing Plants by Type and Area

In terms of physical numbers, the region's existing kill-capacity is dominated by 396 packing plants with cattle-killing capabilities of less than 20 head per hour (Table 4). It should be pointed out that many of these small plants perform a dual role by slaughtering calves as well as cattle. Consequently, the numbers of calf slaughter establishments identified in Table 4 are also handling cattle and are not wholly separate establishments in most cases. Indeed, many of these Northeastern packers, who represent these 396 small firms, also slaughter hogs and sheep. Such data, however, were deleted in order to focus specifically on the killing and processing activites connected with cattle and calves.

Although the physical plant conditions of these small firms are good and periodically updated in order to maintain their federal certification from the U.S. Meat Inspection Service, the method of slaughter used is often the conventional bed-type kill system that was popular in the 1940s. Larger volume plants typically use the prevailing on-the-rail system, with the carcasses moved by gravity along the rail in all but the largest regional

plants (e.g. over 50 head per hour) which have mechanical power systems. The increased labor efficiency of the rail system over the bed system has caused the former to be adopted for virtually all new plant construction (Smalley).

According to unpublished Food Safety and Inspection Service (FSIS) data, only 11 cattle-slaughtering establishments operate at kill-line speeds in excess of 19 head of cattle within the Northeastern region, while calf-slaughtering activities above this hourly kill-level are found at 34 establishments. There is double counting duplication in these figures since some of the larger cattle-killers also slaughter calves on a high-volume basis.

Slaughter Capacity Utilization of Existing Plants by Meat Animal Class

Although small operators tend to dominate regional slaughter activity in terms of sheer physical numbers, the reverse is true in terms of actual productive killing-capacity. For purposes of simplification, the discussion will focus first on operators with kill rates in excess of 19 head per hour; subsequently, attention is turned to those packers with lower kill-line speeds.

1. Regional plant activities of packers with slaughter capacities exceeding 19 head of livestock per hour -- The annual FSIS production data presented in Table 5 show that the 11 cattle slaughtering establishments with kill-line speeds of 20 head or more per hour processed some 685 thousand head of cattle during 1979, or 56 percent of the 1.2 million cattle slaughtered within the region that year. Calf slaughter activity among the larger regional packers parallels the situation found for the cattle-slaughtering operations, but in a more intensified manner. During 1979, the 34 federally approved

TABLE 4.--Number of federally inspected meat establishments slaughtering cattle and calves by region and states in the Northeast, 1980[1/].

Area	--- Packing plant size in kill-capacity per hour ---													
	1-4 head		5-9 head		10-14 head		15-19 head		20-49 head		50+ head		all capacities combined	
	--- Number of facilities[2/] ---													
	Cattle	Calves	Cattle	Calves	Cattle	Calves	Cattle	Calves	Cattle	Calves	Cattle	Calves	Cattle	Calves
New England	35	8	4	-	1	-	-	-	2	1	-	2	42	11
New York	70	33	9	21	4	3	2	5	2	9	1	7	88[3/]	78
New Jersey	18	5	1	5	-	3	1	3	1	3	-	1	21	20
Pennsylvania	219	69	29	23	3	3	-	2	2	8	3	3	256[4/]	108
Total Northeast	342	115	43	49	8	9	3	10	7	21	4	13	407[5/]	217

1/ Data pertaining to the number of establishments slaughtering cattle and calves were acquired directly from field offices of the Food Safety and Quality Service, USDA located in the Northeast region. It should be pointed out that these numbers are very fluid and not even constant from month to month within any given year. Packing plants close and reopen for numerous reasons, including remodeling activities, suspension of Federal plant certification, fires, changes in ownership, union strikes, and bankruptcies to name but a few of the causes for temporary and, in some cases, permanent plant closures.

2/ Many of the packing plants that operate within the Northeastern region kill and process more than one species of livestock and for this reason are referred to as multi-specie, slaughtering facilities. Consequently, the number of slaughtering establishments, as set forth in this table under the columns labeled "Calves" are in most cases duplications since calves are often slaughtered in combination with cattle in the same packing plant, but on separate kill-lines. Many of these plant operators also slaughter hogs and sheep as well, but such data have been deleted for purposes of this study.

3/ Two of the 90 total packing plants operating in the state of New York during 1980 slaughtered calves exclusively.

4/ Eight of the 264 total packing plants operating in the state of Pennsylvania during 1980 slaughtered either calves, sheep, or hogs exclusively or in some combination, but not in combination with cattle killing operations.

5/ The total of 407 plants which slaughtered cattle during 1980 differs from the total number of all slaughtering establishments, which as set forth in Table 1 was 417, because of the explanations delineated in footnotes 3 and 4.

TABLE 5 --Annual plant utilization of commercial cattle and calf slaughtering establishments in the Northeast region, 1979[1/]

Plant size in kill-capacity per hour by meat animal class	Number of federally inspected plants[2/]	Annual production of existing plants[3/]	Percent of kill-capacity utilized[4/]	Potential annual production of existing plants	Potential annual production of existing plants with four additional hours of overtime per week
Cattle	--- number ---	--- thous. head ---	--- percent ---	--- thous. head ---	--- thous. head ---
1 - 19 head	396	537,652	22.75	2,363,642[5/]	2,363,642[6/]
20 - 49 head	7	276,128	71.47	386,382	430,686
50+ head	4	408,520	80.43	507,920	566,160
All capacities combined for Northeast region -	407	1,222,300	37.52	3,257,944	3,360,488
Calves					
1 - 19 head	183	169,949	10.32	1,647,112[5/]	1,647,112[6/]
20 - 49 head	21	202,250	19.19	1,053,934	1,174,782
50+ head	13	777,701	33.03	2,354,572	2,624,511
All capacities combined for Northeast region -	217	1,149,900	22.74	5,055,618	5,446,405
Total Northeast kill-capacity for both meat animal classes -	624[7/]	2,372,200	28.53	8,313,562[5/]	8,806,893[6/]

1/ Represents most current annual data available for such unpublished information concerning annual plant production and annual hours operated as identified by individual federal plant establishments.

2/ Data were not broken out separately by state or area to avoid disclosure of confidential information.

3/ Livestock Slaughter - Annual Summary for 1979, Mt. An. 1-2-1 (80), Crop Reporting Board, ESCS, U.S. Department of Agriculture, Washington, DC. 1980.

4/ Kill-capacity utilization data presented in this table represent annual levels attained by the plants as a group within each category of rated kill-line speed capacity by meat animal class for 1979. This measured use of industrial plant capacity for each group of firms was determined by comparing the actual numbers of animals slaughtered by these Northeastern packers and the total number of hours each plant slaughtered in 1979, as reported by federal inspectors at each plant, with each plant's rated kill-line speed and what could have been produced if each plant had operated at its normal line-speed at annual levels of productivity attained when operating each plant for 7.2 hours per workday for 252 days per year. An annual plant operating average of 1,814 hours per year allows for weekends, 8 holidays, daily work breaks averaging two 15 minute periods or one of 30 minutes duration, and production delays which would average 18 minutes per workday on an annual basis. Many packers operate on a single-shift basis with 7.2 hours of actual productivity per workday for 252 days per year.

5/ These estimated potential production figures for small plants represent what such existing operators could achieve based on the size of their existing kill-floors and kill line-speeds, if labor resources were available to devote to actively slaughtering 7.2 hours per workday and if existing cooler capacity could accommodate such kill levels.
However, the scope and magnitude of such productive potential are in fact overstated for the following reasons. Most of these small killers process several animal species with their labor crews closing down one animal class kill-line to initiate activities at another. Also, the labor forces of such small plants normally perform other plant duties, such as carcass-breaking and retailing activities, which would prevent them from remaining on the kill-floors for 7.2 hours per workday. Many plants, in fact, only kill one or two days per week. The actual availability and accessibility of livestock for uniformly scheduled slaughter also plays an important role in the actual level of productivity such small plants are capable of achieving with regard to the full utilization of their industrial capacity. Likewise, inclement weather such as snow storms and the like will effect annual plant productivity figures as well.
Nevertheless, given the necessary labor and cooler capacity inputs, these small packers could physically achieve the production potentials for cattle and calf slaughter as stated in this table. The potential is real and it is there.

6/ The potential production data for packers operating at kill line-speeds of 1 to 19 head per hour were not expanded to reflect an additional 4 hours of overtime work per packing plant for reasons cited in footnote 5.

7/ This figure represents the actual number of existing kill-lines available to slaughter cattle and calves in the Northeastern region, but does not accurately reflect the total number of existing facilities established for such purposes as certified by the USDA's Food Safety and Inspection Service. Many Northeastern packers slaughter both cattle and calves as well as other species in the same facility. See footnotes 2, 3, 4, and 5 appearing in Table 12 for a further detailed explanation.

establishments with hourly calf-killing capacities of 20 head or more accounted for 980 thousand head of the 1.1 million calves processed in the region for the year (85%).

While these figures indicate a definite concentration of productive capacity among a relatively few large regional packers, the concentration would have been even more substantial if these plants had operated at their official USDA-rated line speeds. The slaughter potential of the 11 cattle-killers in 1979 was 894 thousand head with a single-shift. By adding just four hours of overtime per week, the aggregate annual capacity for the two groups of killers shown in Table 5 could have jumped to 997 thousand head.

Operating a packing plant at 100 percent of its capacity on an annual basis requires that the plant functions at its normal line-speed on a single-shift basis for 7.2 hours per workday for 252 days per year, for a total of 1,814 productive hours. Only 6 of the 11 beef packers in the two groups shown in Table 5 averaged this number of hours or more per year, and not one single plant in the region was able to match its officially rated line-speed for the entire 52 week period. However, three firms came very close to achieving those operating levels and in so doing boosted the plant utilization percentages for the two groups of cattle-killers with hourly line-speeds in excess of 19 head of livestock.

Excluding these three firms, the average percentage utilization figures for annual plant use would have been uneconomically low. In fact, even with the three productive firms included, plant utilization averages must still be considered quite low in view of the high plant overhead costs and narrow profit margins characteristic of the meat packing industry. The extent of this overall underutilization of existing cattle slaughter facilities, taken as a group, must be categorized as being notably poor.

A review of the operating activities among the 34 high-volume, calf slaughterers produced even more startling results. For example, four of these operators averaged using their calf-killing lines for less than 20 hours of total operating time over the period of one year. Moreover, only five of the 34 calf-processors slaughtered in excess of 1,000 hours during 1979 and none of the firms achieved an annual productive operating level of 1,814 hours. Only two packers came close to operating their facilities at capacity. Consequently, both groups of high-volume calf killers produced extremely poor results in terms of industrial plant use, which visibly demonstrates the massive excess in calf-slaughter capacity that currently exists in relation to the current supply of slaughter calves.

Since this study began, four of the eleven beef-packing firms with plant capacities exceeding 19 head of cattle per hour ceased all slaughtering activities and closed. One firm was out of operation for only a few weeks. It appears that two plants may ultimately reopen. Although both firms have modern kill-floors which permit their facilities to be operated at reasonable levels of in-plant productivity and efficiency at existing kill-line speeds, both plants are old enough to have had sizeable amounts of their capital investment costs depreciated. Therefore, between having the opportunity to operate these facilities with relatively low annual fixed costs and having no substitute uses for these plant facilites, it is reasonable to assume that both plants may be reopened. Based on similar economic logic, it also appears likely that the creditors of the now bankrupt packing firm will either hire new managers to reopen the plant, or sell the facility to others.

Considering the fact that the nation is now in a recession and that the United Food and Commercial Workers International Union has only just recently begun to temper their wage demands, it would appear that the above outlook expectations for these three regional beef packers are not overly optimistic. Furthermore, given the current levels of plant utilization for the 11 Northeastern packers, what seems most surprising is that only 3 of the 11 firms found themselves in financial or labor-related difficulties during the current economic downturn. Apparently, the region's calf-killers have survived by turning to the slaughter of other animal species and to other processing activities available to them as diversified meat operators.

Nevertheless, considering the situation at the time of this analysis, it seems appropriate to develop an analysis that would predict the impact on the region's beef industry if all three of the shut down plants remained closed permanently. During 1979, these three firms slaughtered a combined total of 133,308 head of cattle at an aggregate industrial plant utilization level of 56.33 percent. In the event the three remained closed, its is estimated that the remaining eight plants, operated at capacity (on a single-shift basis) would come very close to making up the 133,308 head killing-capacity deficit. Moreoever, if each of the remaining plants were operated at capacity for an additional four hours of overtime per week, they could slaughter and process an additional 49,338 cattle. Thus the region's potential for large packers would not appear to be hampered by the permanent closure of all three federally approved establishments.

2. Regional plant activities of packers with slaughter capabilities below 19 head of livestock per hour ---------- As shown in Table 5, the 396 cattle slaughterers that have been classified in this study as small processors with hourly kills below 19 head actually accounted for the slaughtering and processing of some 538 thousand head of cattle during 1979, or 44 percent of the entire 1.2 million cattle slaughtered within the region that year. However, the level of calf slaughter activity achieved by the 183 small calf processors with kills below 19 head per hour was significantly less satisfactory. They accounted for only 170 thousand head of the 1.1 million calves processed in the region during 1979. This means that as a group, the 183 small calf-killers slaughtered less than 15 percent of the region's total output of veal that year.

While these small processors were reasonably well represented in terms of the region's total annual cattle-kill in absolute numbers, the extent of their beef industry participation nevertheless must be considered meager at best in view of the actual use made of their existing aggregate killing capacity. Taken as a group, these 396 firms utilized only 22.8 percent of existing industrial capacity with respect to their cattle-slaughtering potential during 1979. The underutilization of calf-slaughtering lines among the 183 operational firms killing calves that year was even more striking. From a productivity point of view, not only were the absolute numbers of calves processed by these small operators down badly in relation to their large operator counterparts within the region, but their existing level of plant utilization in 1979 deteriorated to the point where only 10.32 percent of the group's existing calf-slaughter capacity was actually utilized that year.

The measured use of kill-capacity for these small Northeastern firms was determined by comparing the actual numbers of animals slaughtered and the total number of hours each plant slaughtered in 1979, as reported by federal inspectors at each plant, with each plant's USDA rated kill-line speed and what could have been produced if each plant had been operated at its normal line-speed at annual levels of productivity attained when operating these plants for 7.2 hours per workday for 252 days per year. The estimates of kill-capacity utilization and potential production for small plants shown in Table 5 represent what these 396 operators actually did achieve in annual productivity during 1979.

However, the scope and magnitude of such productive potential for these 396 firms are in fact overstated, for the following reasons. Most of these small killers process several animal species with their labor crews, closing down one animal-class kill-line to initiate activities at another. Also, the labor forces of such small plants normally perform other plant duties besides slaughtering, such as carcass-breaking and retail activities, which would prevent them from remaining on the kill-floor for 7.2 hours per workday. Furthermore, many plants only kill one or two days per week. Besides these technical in-plant considerations, the actual availability and accessibility of livestock for uniform slaughter scheduling also plays an important role in the actual level of productivity such small plants are capable of achieving with regard to the full utilization of their industrial capacity. For example, inclement weather such as snow

storms and the like will affect annual plant productivity data. Nevertheless, given the necessary livestock availability and sufficient labor and cooler capacity inputs, these small packers could physically achieve the production potentials for cattle and calf slaughter as stated in Table 5.

Since the projected potential annual production of these 396 existing plants is several times greater than the level of cattle and calf production achieved in 1979, no attempt was made to estimate their potential annual production with an additional four hours of overtime per week. Based on available plant data and interviews with officials of the Food Safety and Inspection Service, these 396 small plants have the aggregate kill-floor and cooler capabilities to more than double their actual 1979 cattle and calf kill levels. Therefore, in the case of cattle slaughter activity, these small processors in the aggregate had the physical potential to handle nearly the entire region's cattle production during 1979.

Since this study was undertaken, 18 of the 396 beef packing firms with plant capacities below 19 head of cattle per hour ceased slaughtering operations, and 15 firms closed altogether. Of those which closed, 13 firms succumbed to banckruptcies and three other plants curtailed their cattle slaughtering functions but retained operational activities in other sectors. It should be pointed out here, however, that the numbers of federally approved establishments open for business are not even constant from month to month within any given year. Packing plants close and reopen for numberous reasons, including the suspension of

federal plant certification and remodeling activities, as well as those cited above.

Of the fifteen plants that currently remain closed, a number will likely reopen under new management, or be sold to others once the current recession ends and economic conditions improve. Nevertheless, even if these plants remained closed, it is unlikely that the group's aggregate cattle-slaughtering potential will decline significantly since it is currently being so grossly underutilized.

When evaluating average annual plant capacity utilization it is important to acknowledge the effects seasonality of supplies can have on these operations. To the extent that slaughter is dispersed irregularly throughout the year, packers are unable to utilize their fixed capacity efficiently. The potential for additional animal supplies will improve the efficiency of the sector in direct relation to the extent to which those animals are supplied to the market on a counter-cyclical basis. Of course, a pro-cyclical supply exacerbates the problem.

Regional cattle slaughter, based as it is on culled cows, is approximately uniform across the year, with modest increases in October and January (Table 6). The fall increase is undoubtedly a response by dairymen to reduce feed demand as they shift to stored feed for the winter season. The reasons for heightened culling in January are not immediately apparent. Calf slaughter is more irregular, with one-fifth to one-third of the volume

TABLE 6 --Annual commercial slaughter of cattle, by months, in New York state and the Northeast region, 1970-80[1/].

Area kill by year	January	February	March	April	May	June	July	August	September	October	November	December	Year Total
						--- thousand head ---							
New York State													
1970	34.0	28.5	32.0	32.0	30.0	30.0	30.5	30.5	33.0	31.0	28.5	33.0	373.0
1972	26.0	21.9	28.0	25.5	29.0	29.0	27.5	33.0	29.0	32.0	31.0	26.5	340.4
1974	29.5	24.0	22.3	22.3	24.0	20.2	24.0	25.5	24.7	29.5	27.0	28.5	301.5
1976	32.0	28.0	30.0	29.5	25.5	26.5	26.0	27.5	30.5	31.0	31.0	31.0	348.5
1978	30.1	28.9	29.9	26.0	27.8	26.1	22.1	26.5	25.4	28.5	27.0	23.8	322.1
1980	24.0	19.3	18.7	19.9	18.2	17.2	18.5	19.7	20.5	23.9	20.1	21.5	241.5
6 year ave.---	29.3	25.4	26.8	25.9	25.8	24.8	24.8	27.1	27.2	29.3	27.4	27.4	321.2
Deviation from 6 year average ($\frac{321.2}{12}$)	(26.8)	(26.8)	(26.8)	(26.8)	(26.8)	(26.8)	(26.8)	(26.8)	(26.8)	(26.8)	(26.8)	(26.8)	(321.6)
a. thousand head	+ 2.5	- 1.4	.0	-.9	- 1.0	- 2.0	- 2.0	+.3	+.4	+ 2.5	+.6	+.6	-.4
						--- percent ---							
b. percent	+ 9.3	- 5.2	.0	- 3.4	- 3.7	- 7.5	- 7.5	+ 1.1	+ 1.5	+ 9.3	+ 2.2	+ 2.2	
Northeast Region						--- thousand head ---							
1970	147.4	125.1	135.4	137.7	132.2	134.8	136.7	131.5	140.5	134.9	123.2	129.6	1,689.0
1972	115.7	107.6	118.8	105.5	117.1	113.8	98.9	123.9	113.5	126.3	122.0	110.3	1,323.4
1974	121.1	101.5	99.2	95.9	111.1	97.4	112.1	120.8	113.0	130.2	127.3	121.6	1,351.2
1976	158.9	140.8	151.3	141.8	137.8	144.2	143.6	146.4	160.7	148.6	160.2	158.8	1,793.1
1978	145.6	137.9	149.4	135.3	142.9	134.2	116.7	127.8	124.8	128.4	122.9	110.1	1,576.0
1980	107.0	89.3	88.1	96.5	93.8	87.9	95.9	98.4	100.2	117.8	100.2	102.5	1,177.6
6 year ave.---	132.6	117.0	123.7	118.8	122.5	118.7	117.3	124.8	125.5	131.0	126.0	122.2	1,480.1
Deviation from 6 year average ($\frac{1,480.1}{12}$)	(123.3)	(123.3)	(123.3)	(123.3)	(123.3)	(123.3)	(123.3)	(123.3)	(123.3)	(123.3)	(123.3)	(123.3)	(1,479.6)
a. thousand head	+ 9.3	- 6.3	+.4	- 4.5	-.8	- 4.6	- 6.0	+ 1.5	+ 2.2	+ 7.7	+ 2.7	- 1.1	+.5
						--- percent ---							
b. percent	+ 7.5	- 5.1	+.3	- 3.7	-.7	- 3.7	- 4.9	+ 1.2	+ 1.8	+ 6.2	+ 2.2	-.9	

1/ Livestock slaughter annual summary series, Crop Reporting Board, ESS, U. S. Department of Agriculture, Washington, D.C., 1971-81.

TABLE 7 --Annual commercial slaughter of calves, by months, in New York State and the Northeast region, 1970-80[1/].

Area kill by year	January	February	March	April	May	June	July	August	September	October	November	December	Year Total
						--- thousand head ---							
New York State													
1970	61.0	54.0	85.0	74.5	56.0	49.0	53.0	54.0	65.5	57.5	56.0	67.0	732.5
1972	52.0	53.0	84.5	55.0	43.5	39.5	42.5	55.5	55.5	54.0	55.0	53.0	643.0
1974	53.5	48.5	62.0	54.0	50.5	40.0	45.5	60.5	58.0	69.0	66.0	72.0	679.5
1976	80.0	76.0	110.0	91.5	64.5	76.5	77.5	87.0	92.5	91.0	90.5	92.5	1,029.5
1978	75.1	71.9	107.3	91.4	73.2	62.1	61.6	76.7	71.0	72.8	66.7	65.1	895.1
1980	54.5	45.6	56.5	49.0	36.3	34.7	42.6	44.5	49.6	52.3	50.4	56.9	578.1
6 year ave.---	62.7	58.2	84.2	69.2	54.0	50.3	53.8	63.0	65.3	67.0	64.1	67.8	759.6
Deviation from 6 year average ($\frac{759.6}{12}$)	(63.3)	(63.3)	(63.3)	(63.3)	(63.3)	(63.3)	(63.3)	(63.3)	(63.3)	(63.3)	(63.3)	(63.3)	(759.6)
a. thousand head	-.6	-5.1	+20.9	+5.9	-9.3	-13.0	-9.5	-.3	+2.0	+3.7	+.8	+4.5	0.0
						--- percent ---							
b. percent	-1.0	-8.1	+33.0	+9.3	-14.7	-20.5	-15.0	-.5	+3.2	+5.8	+1.3	+7.1	0.0
						--- thousand head ---							
Northeast Region													
1970	150.0	132.8	176.1	149.7	122.4	113.6	131.8	132.6	151.1	141.4	131.5	150.6	1,683.1
1972	120.4	116.3	159.1	110.5	99.0	89.0	95.2	123.8	117.3	120.9	118.6	114.6	1,384.7
1974	104.1	91.2	111.6	99.8	91.5	76.5	92.6	115.8	109.6	130.8	123.8	131.6	1,278.9
1976	158.8	148.0	212.0	170.8	132.4	150.3	155.7	171.6	186.3	179.3	178.6	181.9	2,025.7
1978	142.1	135.1	186.9	153.9	130.0	115.9	116.9	139.2	129.5	128.4	119.1	118.1	1,615.1
1980	100.2	86.9	102.9	91.6	69.0	63.4	83.1	86.6	95.4	108.4	92.4	103.9	1,083.8
6 year ave.---	129.3	118.4	158.1	129.4	107.4	101.4	112.5	128.3	131.5	134.9	127.3	133.4	1,511.9
Deviation from 6 year average ($\frac{1,511.9}{12}$)	- (126.0)	(126.0)	(126.0)	(126.0)	(126.0)	(126.0)	(126.0)	(126.0)	(126.0)	(126.0)	(126.0)	(126.0)	(1,512.0)
a. thousand head	+ 3.3	- 7.6	+ 32.1	+ 3.4	-18.6	-24.6	- 13.5	+ 2.3	+ 5.5	+ 8.9	+ 1.3	+ 7.4	-0.1
						--- percent ---							
b. percent	+ 2.6	- 6.0	+ 25.5	+ 2.7	-14.8	-19.5	- 10.7	+ 1.8	+ 4.4	+ 7.1	+ 1.0	+ 5.9	

1/ Livestock slaughter annual summary series, Crop Reporting Board, ESS, U. S. Department of Agriculture, Washington, D.C., 1971-81.

handled in March as a result of the persistent trend in early-spring freshening (Table 7).

A review of the monthly slaughter statistics from the region suggests that the operators are running their plants at more uniform levels than would be possible if only local supplies were used. Apparently seasonal deficits are being made up by imports from outside the region.

Competitiveness of Existing Slaughter Plants in the Northeast

Meatpacking is a very low profit margin business. Over three-fourths of every sales dollar is returned to the livestock producer as a raw material expense to the industry. Of the 21.6 percent that initially remains as gross operating margin, approximately 10.3 percent goes for employee wages and benefits. Interest, depreciation, utilities and rents as well as supplies and miscellaneous items account for another 9.6 percent, which leaves 1.7 percent for earnings before taxes. After all expenses and income taxes, present net profits are about 1.0 percent of sales industry-wide and have averaged as low as 0.97 percent over the past decade (Wilson).

Because of these existing industry conditions, most successful operators are those who can generate profits by striving to attain high-volume sales. Consequently, high-volume packers have an inherent advantage over smaller firms. But of even greater importance in competitive advantage is their ability to utilize more fully the technological innovations available to the industry. This permits them to obtain significant economies of scale in their daily processing operations. Such competitive processing advantage enables large packers to successfully reduce their unit killing costs per animal by as much as half or more over their competition.

Within the last two decades, these large packers have also improved further processing activities center around the fabrication of animal carcasses into primal cuts, which are then bagged and boxed. However, creative innovators are now in the process of extending profits still further by fabricating their carcass raw materials into portion-controlled meat items for the hotel, restaurant and institutional (HRI) trade, as well as for direct sale to consumers through supermarket chain-stores.

When comparing northeastern packers with their national rivals, their competitive position must be viewed as being tentative at best. Locational advantage places them close to huge numbers of consumers, but all other competitive factors appear to put most northeastern firms at a significant competitive disadvantage. The extent of the disadvantage analyzed here is significant, since it gives an indication of the future viability of the sector in the Northeast. During the subsequent discussion, it is helpful to keep in mind that virtually all northeastern plants are small by national standards.

Information for this section is derived from interviews conducted with managers of several cattle packing plants in New York and Pennsylvania during the winter of 1981. The interviewed firms were randomly selected from a sample stratified by size and location so the results should be representative of the entire regional cattle packing industry. Stratification allowed a selection of a large sample of the biggest packers, but only a 10-15 percent sample of the more numerous, smaller firms.

Cattle Slaughter Costs Per Head and Labor Productivity Per Man-Hour

The following production cost estimates for northeastern packers are

based on information gathered during personal interviews. However, because of management's understandable reluctance to reveal highly confidential information or their imprecise knowledge of costs, the data reported here should be viewed as only operating norms for various size packers operating within the region. In reality, not all production costs are strictly comparable since some firms employ union labor while others do not. Packers also have different power sources and therefore varying electrical, gas, or oil charges as well as varying water and sewage charges. Moreover, some packers attempt to salvage all of their animal byproducts as well as process all viscera and bones, while others do neither. Packers integrated into byproducts processing often have very high overhead expenses, but are able to achieve significant "drop" credits, which can generate substantial additional income for very high-volume firms. However, all of these additional plant functions do tend to escalate a firm's production costs and lower kill-floor productivity when hot offal work-up crews are expanded to salvage all byproducts from the animal carcasses.

Maximum kill-line speed for packers operating in the Northeast region is 100 head per hour for cattle, and 225 head per hour for calf slaughter. However, of those packers interviewed for production cost information, the maximum kill-line spped was 65 head of cattle per hour, while the lowest was 35 head per hour. Raw data from the interviewed firms consisted of a range of values which exceeded reasonable expectations based on a knowledge of the costs of national packers and internal consistency among the estimates. The values varied in part as some of the packers may have provided kill-cost estimates without fully considering all of the indirect or fixed costs associated with their production operations. Consequently, judgment was used in making some adjustments and allowances in the raw figures leading to accepted values ranging from a low of about $28 per head to a high of about $45 per head.

Estimates of kill-floor productivity per man-hour were less difficult to obtain since it involved specific answers to questions concerning employee numbers and functions, length of daily work shifts (less breaks and production downtime), and the average number of cattle killed per day, or average daily carcass-cooler count. The labor productivity estimates for large northeastern packers ranged from a low of 1.02 cattle per man-hour to a high of 1.75 cattle per man-hour.

The small northeastern packers that were interviewed had a maximum kill-line speed of 19 head of cattle per hour and a minimum, or lowest operating line speed of two cattle per hour. Their adjusted unit killing costs ranged from a low of about $34 per head to a high of about $40 per head. Similar data problems occurred with the low-volume packers as were experienced with the larger operators during the survey interviews. Accordingly, similar adjustments and allowances were made in these estimates as well to reflect the shortcomings in packer estimating procedures.

Small packer estimates of kill-floor productivity were readily available for the same reasons previously cited and, through visual inspection, tended to reflect actual conditions closely. The labor productivity estimates for small northeastern packers ranged from a low of 0.78 cattle per man-hour to a high of 1.40 cattle per man-hour. These operators were also much less efficient in their salvage operations. Typically, only the hide, liver, tongue, kidneys, head and cheek meat, and oxtails were saved, with all remaining carcass byproducts being sold to renderers along with animal viscera and bone wastes.

Some of the variables affecting kill-floor efficiency directly involve the class and grade of cattle being slaughtered. The average weight of these cattle is also very important as well as the equipment and layout being utilized, the training, speed, and skill of the work force in question and their overall morale. Job assignment shifts come into play as well and

can often directly affect employee morale. Inspection and sanitation control are indirect factors that can influence overall productivity.

Furthermore, if a future shift in production emphasis of beef cattle over dairying does occur within the Northeast region, small packers can be expected to benefit most, since cattle inventories would likely continue to remain widely dispersed. The small processor, with his integrated and flexible industry sector participation, is positioned to react quickly to rapidly changing economic conditions. Many also possess locational advantages of being close to remote cattle supplies while at the same time still remaining reasonably close to metropolitan demand centres. Circumstances such as these will likely continue to help him maintain his unique competitive advantage despite the inefficiencies that might exist in his kill-floor operations. Respectable retailing markups of 25 to 28 percent cannot be overlooked either, particularly when many of these small operators conduct their retailing activities out of the same facility in which they slaughter. Such combined operating functions automatically lower their indirect, or fixed, retailing costs and enable these small firms to utilize their direct or variable labor inputs more efficiently.

Comparisons With Plants in the Midwest and Far West

The general consensus among packers nationwide is that industry leaders presently set the standard for competition. Although neither firm will openly divulge their slaughtering or fabricating production figures, others within the industry have made penetrating analyses and have come up with approximate production cost ranges for these firms' killing costs per head. These best

estimates indicate that the acknowledged industry leader has slaughtering costs of about $18 to $20 per head. Productivity levels are probably around 2.5 cattle per man-hour (Meat Industry, 1981).

Although this firm operates several slaughtering facilities, its newest plant is probably the largest single-unit packing facility in the world with the potential to handle over one million head annually. Other features of this complex include a fully automated rendering system and a hide-curing department. Several other supporting facilities are also located on the plant's premises, including a self-contained sewage treatment system for waste water pollution control.

Production cost estimates for the number two firm at about $21 to $22 per head for slaughtering are very close to the preceding estimates. Productivity is probably in the vicinity of 2.4 cattle per man-hour. Other packing plants that were also considered to be operated efficiently had estimated costs of about $23 per head. Therefore, as a rule of thumb, in order to be competitive at this time, packers need to aim at production costs in the low $20s when slaughtering uniformly finished fed cattle.

Assembly and Distribution Costs

When conducting feasibility studies, industry consultants always augment an analysis of estimated in-plant production costs with an analysis of assembly and distribution costs so that in-plant economies of operation are not offset by excessive cost for procurement. One of the inherent locational advantages midwest and far west packers have is being literally next door to their

raw material requirements. Monfort of Colorado, Inc., for example, is a fully integrated concern with its own feedlots. Consequently, Monfort's managers measure their procurement distance by mere miles. Other nonintegrated packers usually manage to acquire most of their cattle needs from procurement distances within a 15 to 150 mile radius of their plants. This contrasts sharply with the procurement situation experienced by existing northeastern packers who must travel distances of up to 1,000 miles to acquire their fed cattle and culls. In this regard, smaller regional packers have an advantage in that most of their supplies are acquired locally.

Northeastern producers have additional cost penalties through their reliance on auction and terminal markets as principal source points. Such markets, while costly, do provide an important assembly function where production is dispersed among small feeders. Trucking costs in the Northeast are also believed to be higher than for the Midwest.

While northeastern packers hold an obvious advantage on the other side of the transportation equation in hauling beef directly to outlets near the consuming public, this advantage has been significantly reduced since the advent of fabricating beef primals at the point of slaughter. A 1,000 pound live steer finished on grain is reduced to approximately 615 pounds of carcass beef after slaughter and then further reduced to 457 pounds of bagged and boxed beef after a fabrication process has taken place at the packing plant. The long distance shipping advantages of the reduction in bulk are obvious, but also important is the improved utilization of the fat and bone that were previously shipped along with the edible beef to consuming metropolitan centers.

From this comparison of costs, it is evident that the net full cost disadvantage of northeastern packers is significant. How then do the regional plants survive? One reason is the age of the plants in the Northeast. Older, fully depreciated plants with little alternative use value can operate at levels just covering variable costs. New, midwestern plants, despite greater operational economies, must nevertheless generate sufficient profits to service a substantial debt.

It is also clear that many northeastern plants have found a "niche" which permits them to avoid direct competition with lower cost firms. These niches range from a source of quick fill-in orders to integrated slaughter-retailing operations, which take most of their profits from the retail margins.

The net effect of these operating differences appears to be a temporary equilibrium in regional cattle slaughter activities. Occasionally, new plants are built or existing ones modernized, while firms at the other end of the spectrum continue to close due to labor demands, locational disadvantages in urban areas, aging of the management staff, or for other reasons. These factors change slowly, so baring major technological advances or shifts in interregional competition, no major alterations of the regional industry structure are expected over the coming decade.

ESTABLISHING EFFICIENT SLAUGHTER PLANT FACILITIES IN THE NORTHEAST

A principal finding of the preceeding analysis was the extent of unused packing plant capacity in the Northeast. Clearly, moderate levels of increased regional production of fat cattle could be handled by these plants. Higher levels of production, although seemingly unlikely at this point in time, would require additional capacity. Capacity could be augmented either by the conversion and modernization of existing plants or by the construction of wholly new facilities. Investment in slaughter facilities can also be justified if the resultant increases in productivity are sufficient to reduce total kill costs.

Modernization of Existing Packing Plants

Under most circumstances it is difficult to visualize fed-cattle supplies increasing in the foreseeable future to the point where new slaughter facilities would be required. It is therefore more appropriate that consideration be given to increasing existing plant efficiency by modernizing kill-floors and adding more productive equipment. The primary factors for consideration are the potential for increasing the size of the kill floor, increasing the speed of the kill-line, and the addition of new, modern equipment to perform the operations more efficiently. Depending on how much the hourly kill rate is increased, it may also be necessary to increase the capacity of the holding coolers.

This approach to industrial revitalization of northeastern packing plant activity could be used to satisfy a potential increase in fed-cattle slaughter in addition to efficiently handling current cull-cow slaughter, which will remain the industry's raw material mainstay for the foreseeable future. Under circumstances where additional fed-slaughter capacity is needed and

excess cull-cow capacity exists, conversion may be a relatively simple and inexpensive procedure. The addition of shrouding stations is typically the only change required. Shrouding is the last operation on the kill floor and is applied just prior to moving the carcass into the chill room. Additional equipment and supplies involved are a hydraulic platform and a supply of pegs and shroud cloths.

Before making a decision concerning the modernization of existing facilities, each situation should be examined thoroughly because plants in the Northeast region have a wide variety of slaughtering arrangements. Instances can be found where both fed-beef and cull-cows are currently being slaughtered in the same facility or where one or the other is handled in conjunction with a calf slaughtering operation. If fed-beef is already a part of the operation, costs of conversion to a complete fed-beef operation will have already been paid.

Construction of New Slaughter Plant Facilities

Costs synthesis, a commonly used economic-engineering technique, subdivides a plant, an operation, or a total concept into a series of stages so that the various pieces can be studied or analyzed separately (Cothern et al.). In the current application of economic-engineering analysis to packing plants, cost estimates were divided into the following segments: land acquisition and site preparation; building, equipment, water and sewage treatment system; paved areas; animal corrals; and architect's fees. A further breakdown was provided for the building and equipment categories since these are the most expensive and the most critical to an economically viable operation. This further breakdown involves the following items: kill floor, chill and sales coolers, boiler and refrigeration systems, hide

curing, rendering, equipment cleanup, dry storage areas, offices, welfare and cafeteria areas, refrigerated docks, dock aprons, parking lots, and corrals. In addition to these specific physical facility requirements and costs, the full range of fixed and variable costs must be considered in order to project estimated kill costs on a unit-basis so that a decision may be reached concerning the feasibility of constructing such a plant.

Estimates of the component costs used in this synthesized analysis were obtained from several sources. The estimates of building and equipment costs were obtained from the engineering department of Koch Supplies, Inc., Kansas City, Missouri, and from Omeco-Boss Co., Omaha, Nebraska. Estimated costs for sewage-treatment systems were obtained from Bell, Galyasdt and Wells, sanitary engineering consultants, Omaha, Nebraska. Land values, site work, and property taxes were acquired from the Utica Chamber of Commerce, Utica, New York. Utility rate estimates were based on those provided by the Niagra Mohawk Power Corp., Utica, New York, the New York State Electric and Gas Corp., Binghamton, New York, and the City of Utica Board of Water Supply, Utica, New York. In many instances, basic data from previous studies (identified in the text) were used and updated by adjusting for inflation as reported by the Council of Economic Advisors in the Economic Report of the President.

A brief description of the physical processes involved in cattle slaughtering is provided to help show the relationship and importance of some of the operations involved.

Corrals: The corrals are a receiving and holding area. Cattle are generally brought in by trucks, inspected as they are received, and placed in holding pens for a short time until needed. Cattle for the day's kill are driven up the loading chute, weighed, and herded into holding pens to await slaughter.

When needed they are driven into the knocking pen one by one.

Kill floor: The kill floor is the heart of the beef slaughtering operation. Kill floors must be of such size and arrangement to conduct and facilitate sanitary operations and efficient performance of inspection services. This is the area where all of the operations involved in converting the animals into finished carcass sides take place. These dressing line operations include: immobilizing, bleeding, eviscerating, removal of heads, hides and feet, splitting the carcass into sides, washing, shrouding and weighing of the sides.

Supporting salvage operations are performed on the kill floor in many plants. However, most larger plants may perform most of the supporting operations in separate work-up areas. Supporting operations include head work-up, viscera removal, hide removal, pluck work-up, and paunch work-up.

The kill floor specifications used to estimate the cost of construction in this study are typical of architectural designs of on-the-rail kill floor layouts that meet USDA Meat Inspection approval.

Chill room: Each carcass side of beef is covered with a canvas shroud to prevent shrinking and to allow fat to mold to the carcass, improving physical appearance. The carcass is then pushed by rail or, in larger plants, mechanically transferred from the kill floor to a chill room. Here the carcasses hang on rails for about 24 hours, chilling to 35°F. The shrouds are then removed and the carcass sides transferred to another holding cooler, where they are graded and split into quarters.

Chill rooms are built in a wide variety of sizes and shapes, usually designed to meet the particular needs of the individual plant. Some of the important factors involved in the design of chill rooms are (1) the type and amount of construction materials involved, (2) the amount and type of

product to be handled, (3) the temperature to be maintained in the room, (4) the outside temperature, (5) the amount and size of electrical equipment in the room, (6) the number of individuals working in the room, and (7) the frequency of air changes.

Total Investment and Fixed Cost Requirements

Costs were allocated by stage of operation in two categories for determining the cost structure of the beef processing plants. These costs were: (1) investment overhead, or fixed costs, and (2) operating or variable costs. Fixed costs are those related to building construction, land, and equipment, expressed as costs associated with depreciation, interest, taxes and insurance. Variable costs are those related to labor, materials, utilities (natural gas, electricity and water), storage, office, telephone, laundry, and other miscellaneous costs. Finally, an allowance must be made for operating capital when determining the total costs of an operation.

Total investment required by stage: Total building and equipment requirements were developed for each stage of operation in detail by the use of economic-engineering analysis and cost synthesis. At the same time the requirements were developed, the depreciation, average investment, interest cost, insurance costs, and taxes were calculated. These data are presented in detail in Appendix Tables 1 through 13.

In determining the advisability of constructing new slaughtering capacity prime consideration is given to major cost items such as land and site preparation, buildings, equipment, water and sewage treatment systems, corrals, paved areas and the architect's fee. (App. Table 1).

The construction of the slaughter facility and related areas must be planned in considerable detail. Major components of this facility (kill

floor, chill cooler, sales cooler, etc.) are shown in Appendix Table 2.

Determining equipment requirements and costs is very important because this is a critical category in making an expansion decision. In broad terms, consideration must be given to refrigeration equipment, kill floor equipment, rendering equipment, and hide curing equipment. Office equipment must be provided for, but cost-wise, this is a relatively minor item (App. Table 3).

The specific amount of investment capital needed depends on plant size and function as well as the type of construction to be utilized and amounts and types of recommended equipment. Current land costs also affect the plant's estimated price tag. The values shown in these accompanying tables of cost estimates reflect current costs for such investment items in New York State. Capital investment estimates were computed for kill capacities of 60, 90, and 120 head per hour. These investment estimates ranged from $8.4 million for a 60 head per hour plant to $13.7 million for a packing plant capable of slaughtering 120 head per hour. Constructing the building and equiping the plant for operation represent the largest cost items and accounts for approximately two-thirds of the estimated costs for each of the three plant capacities.

Estimated facility requirements and construction costs are shown in App. Tables 4, 5 and 6. For each different kill capacity, the facility areas or components requiring the most space, and the most expensive space on a per unit basis, are the kill floor, the chill cooler and the sales cooler. There are economies of scale in both per unit space requirements and costs as plant size moves from smallest to largest. The average estimated cost per square foot is $126, $120, and $114 respectively for the three synthesized plants with hourly kill capacities of 60, 90, and 120 head per hour.

Interest: Interest costs were determined by multiplying the average investment times a 15 percent interest rate for capital investment items. Average investment was determined by dividing total investment by 2. This represented a linearly decreasing average investment function for the items considered (App. Table 6).

Interest costs gradually dropped from $4.08 per head slaughtered for the 60 head per hour operation to about $3.43 for the 120 head per hour operation.

Taxes: Taxes that would be average for typical New York State communities were calculated as $17.35 per $100 of the asset's assessed value which at the time of writing was 23% of the estimated market value (App. Table 7). Tax costs ranged from $2.64 per head for the 60 head per hour plant to $2.16 per head in the 120 head per hour plant.

Insurance: Insurance costs, determined after consultation with insurance carriers, continually decreased from about $.44 per head slaughtered for the smallest size operation to about $.37 for the largest.

Total building and equipment fixed costs: Total building and equipment fixed costs varied from about $9.41 per head for the smallest size operation to $7.86 per head for the largest (App. Table 8). Fixed costs decreased about $1.55 per head when plant size doubled from 60 to 120 head per hour.

Total Variable Costs

Variable costs were basically categorized as labor, utilities, other supplies and services, and interest on operating capital.

Labor: Labor costs are the largest single variable cost item and account for approximately one-half of the total per head slaughtering costs (App.

Tables 9, 10, and 11). Labor costs are subdivided into kill floor costs, supporting operations costs, salaried personnel costs and tax and welfare costs. Tax and welfare costs include social security taxes and the costs of insurance to cover workman's compensation and general liability expenses.

Total labor costs are $16.22 per head in the 60 head per hour plant, $14.39 per head in the 90 head per hour plant, and $13.45 per head in the 120 head per hour plant. Thus, it can be seen that there are some economies of size, but packing plant operations are labor intensive and these reductions indicate more flexibility and better utilization of worker skills as plant size increases (Franzmann and Kuntz).

Utilities: Utilities account for approximately 5 to 6 percent of the total per head slaughter costs in the plant sizes considered. Utility cost on a per head basis varied very little, ranging from $1.72 in the smallest plant to $1.66 in the largest. In computing utility costs, gas, electricity and water and sewage treatment were considered (Wissman, and Logan and King). Water and sewage treatment was the largest expense item, and accounted for almost one-half of the total costs for all sizes of plants (App. Table 12).

Other supplies and services: For purposes of this study, other supplies and services include telephone, laundry, miscellaneous supplies, and repairs and maintenance. The data did not indicate any appreciable economies as size increased for this category of expense. All three plant sizes are estimated at $3.12 per head slaughtered. App. Table 13 shows the breakdown on these expenses.

Interest on operating capital: There is a cost of making money available to operate cattle slaughtering plants. This expense accounts for

approximately 2.5 to 3 percent of the total slaughter costs.

Total annual variable costs: Variable costs accounted for approximately 70 percent of the estimated total annual cost on a per head basis. As previously stated, labor was the major cost item. In the 60 head per hour plant, $16.22 of the $21.83 per head variable cost was for labor, compared to $14.39 of the $20.00 in the 90 head per hour plant and $13.45 of the $19.05 in the 120 head per hour plant. Although there were some individual variations, the remaining variable costs averaged out almost the same for the three sizes of slaughter plants studied.

Total Fixed and Variable Costs

Total fixed and variable costs ranged from $31.24 per head in the smallest plant to $26.91 per head in the largest plant (Figure 1). There is a per head reduction which was estimated to be about 14 percent when plant capacity is doubled from 60 to 120 head per hour. The economies apply to both fixed and variable costs.

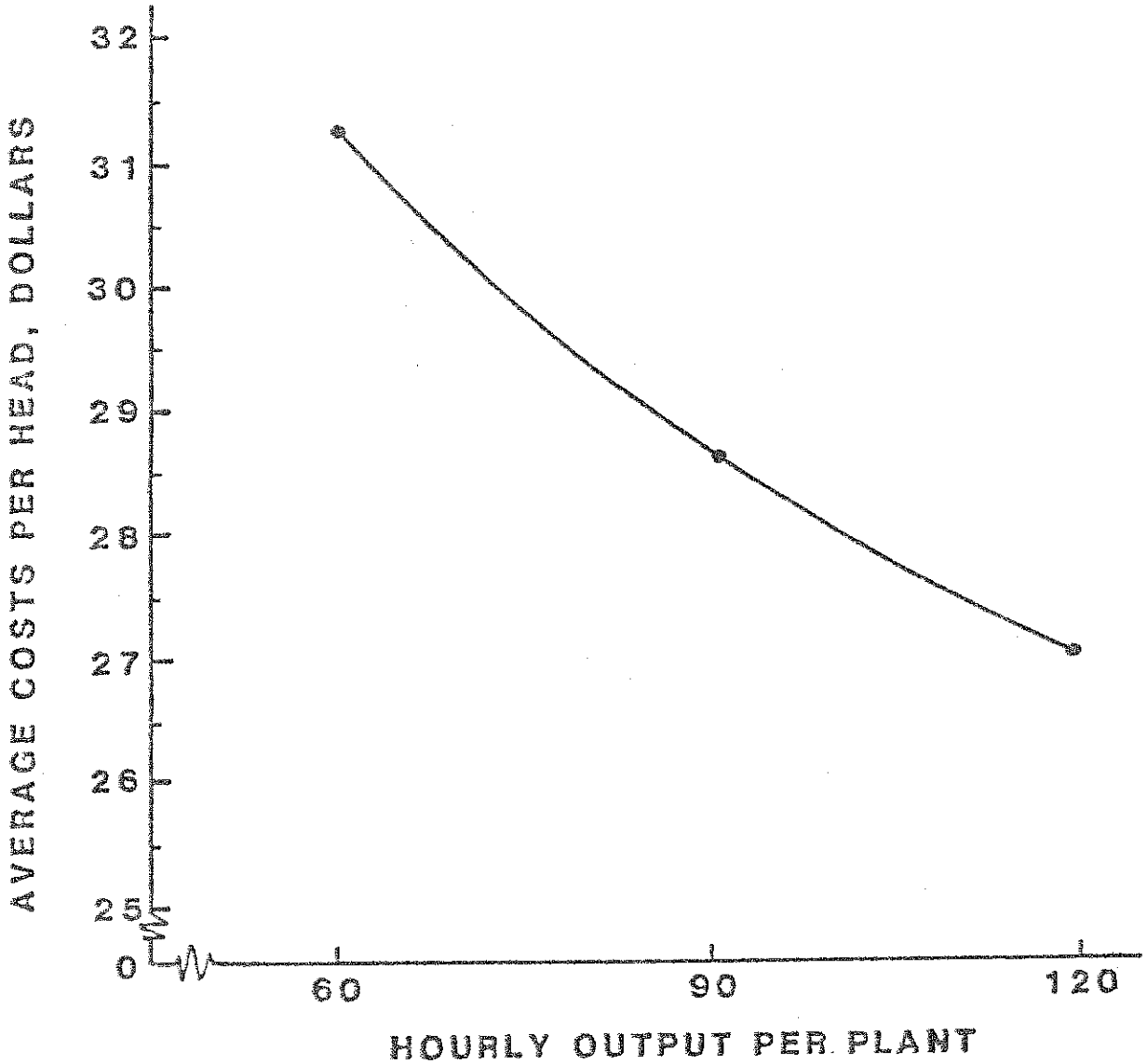
Fixed costs, which include depreciation, interest, insurance and taxes, accounted for about 30 percent of total costs. Variable costs, which include labor utilities, other supplies and services, and interest on operating capital, accounted for the other 70 percent. As mentioned earlier, labor is the largest single expense item, accounting for approximately 50 percent of the total.

Finally, when calculating total operating costs, the need for working capital must be considered. Due to the competitive and regulatory nature of the livestock industry, the requirements for working capital are disproportionately high. Packers, by law, are required to pay for their live animals within a short period from purchase. Sales of meat are not similarly

regulated, and accounts are typically settled in 10 to 14 days, with delays of up to 30 days not unknown. Bad debts are also a persistent problem in the industry.

As a result of the two to three week period between the payment for the live animals and processing costs and the receipt of payment from customers, the requirements for operating capital are large. Current rules-of-thumb dictate a fixed to operating capital ratio of .95 to 1 for small firms , 1 to 1.27 for medium sized operations, and up to 1.50 for the largest companies (Smalley, p.33). The actual requirements, of course, vary according to animal and labor costs, and interest rates as they directly influence the rapidity of payment by customers.

FIGURE 1: AVERAGE COST FUNCTIONS FOR THREE SYNTHESIZED ON-THE-RAIL CATTLE SLAUGHTER PLANTS



SUMMARY AND CONCLUSIONS

This study was undertaken to evaluate existing regional beef packers as outlets for northeastern-produced cattle and calves, with special emphasis being placed on their ability to accommodate future increases in the number of fed-cattle that may be produced in the region from dairy cattle. Recent research at Cornell University has identified opportunities for combining underutilized bob calves and forage in the production of feeder calves and fed beef. These animals would be an addition to the estimated 151,000 head of fat cattle produced in the Northeast in 1980.

The results of a thorough evaluation of 407 federally inspected plants currently killing cattle in the Northeast indicate that even a doubling of locally available fed cattle for slaughter within the region would not create any significant marketing problems. Regional packers with hourly kills of 50 head per hour and higher had a plant utilization factor of 80 percent during 1980, while operators with lower hourly kills experienced plant utilization levels of under 40 percent as a group. Much of this kill was made up of cattle imported from outside the region, which constituted 47 percent of the 1.2 million cattle slaughtered by northeastern packers in 1980. Without these additional slaughter cattle procurements from other regions, the 407 federally inspected establishments would have witnessed substantially lower plant utilization levels of regional cattle slaughter capacity.

Nevertheless, in an effort to determine whether these existing packers would be able to accommodate substantial further increases in marketing of fed cattle from local dairy herds, regional inventories of all cattle and calves were evaluated with projected northeastern herd estimates made through 1990. The findings of this analysis indicated that farm inventories of

regional cattle and calves will probably remain flat at around 4.6 million head or decline slightly over the next several years. Moreover, if milk support prices are reduced from current levels during the decade, northeastern farm inventories of cattle and calves may actually decline, since dairy herds comprise 87 percent of the regional total.

Since physical plant capacity in the Northeast exceeds current cattle slaughtering activity by more than 160 percent, and calf slaughter by more than 330 percent, the overall competitive position of the region's packers must be viewed as less than favorable. By comparing northeastern packers with their counterparts in the Midwest and Far West, it was determined that most packers in the Northeast had significantly higher killing costs per animal unit and were not as productively efficient as those packers in other regions that compete for the Northeast's beef market.

Northeastern packers with kill-line speeds between 2 and 65 head of cattle per hour had unit-killing costs that ranged from a low of about $28 per head to a high of about $45 per head. Their labor productivity rates ranged from a low of 0.78 cattle per man-hour to a high of 1.75 cattle per man-hour. Those packers in other regions that are in the best position to compete for the northeastern beef market consist mainly of high-volume cattle slaughterers with kills in excess of 150 head per hour. Best estimates indicate that their slaughtering costs range from about $18 to $22 per head, while their labor productivity rates range from about 2.4 to 2.5 cattle per man-hour.

There are several reasons why northeastern packers are less efficient and productive than their competitors in other regions. Almost 400 of the 407 cattle slaughtering plants in the Northeast are low-volume operations

with kill rates under 19 head of cattle per hour. Moreover, the bulk of these low-volume operators actually fall into an hourly kill category of from 1 to 5 head of cattle. The majority of these 400 small packers utilize outdated and inefficient kill-bed systems for slaughtering their animals rather than modern, on-the-rail killing systems. And those in the Northeast with rail systems use the gravity-flow method almost entirely, as opposed to the more productive power-train drive method, which must be used on kill floors with speeds in excess of 80 head of cattle per hour.

Nevertheless, many of the small packers in the Northeast are vertically integrated, enabling them to merchandise their beef directly to the public at retail prices. Also, few northeastern packers are large enough to be negatively affected by unions with their occasional wage-rate problems and work stoppages. Consequently, even though these operators are relatively inefficient from a kill-cost point of view, they remain profitable and continue to be a viable marketing force in their respective trade areas. With relatively small kills, these operators can satisfy their weekly cattle requirements locally, even though their respective livestock procurement areas have sparse herd inventories. Larger local competitors, however, suffer significantly from high procurement costs when compared to their midwestern and far western counterparts, mainly because of the low cattle density in the Northeast.

The high costs of pooling fed cattle from small herds into uniform truckload lots will probably remain a major limitation in the foreseeable future for any new operator seeking to acquire large volumes of quality cattle for immediate slaughter in the Northeast. Consequently, even under the most optimistic circumstances, it would be difficult to visualize the economic

feasibility of constructing new slaughter plant facilities in the region. The cost of constructing and operating such new facilities within the region would range from about $19.1 million for a plant killing 60 head of cattle per hour to about $34.3 million for a plant operating at 120 head per hour.

The conversion of existing cow killers to fed beef slaughter appears preferable to constructing wholly new facilities. Such conversions are straightforward, requiring only the addition of shrouding stations. A second alternative to new construction is the transformation of existing plants through the use of more productive equipment. Bed-type systems can be made more productive through conversion to overhead rails, and gravity-flow methods can be converted to power-train drive procedures. In individual cases, an increase in the kill level will require an expansion of cooler capacity.

APPENDIX TABLES

APP. TABLE 1 .--Estimated capital investment requirements for three sizes of cattle slaughter plants in 1981.

Item	Capital investment by plant size in kill capacity per hour		
	60 Head	90 Head	120 Head
Land[1/]	487,300	632,800	720,000
Site work[2/]	44,000	57,000	65,000
Building	3,532,267	4,792,583	5,758,194
Equipment	1,916,363	2,833,796	3,529,498
Water system[3/]	434,400	593,200	672,000
Sewage-treatment system[4/]	643,200	751,200	837,600
Paved areas	80,896	120,282	159,473
Corrals	990,792	1,289,520	1,525,068
Architect's fee[5/]	276,237	372,143	446,564
Total	8,405,455	11,442,524	13,713,397

1/ Land requirements and costs are based on the following estimates: (1) For the 60-head-per-hour plant, 75 acres @ $6,500 per acre; (2) for the 90-head-per-hour plant, 113 acres @ $5,600 per acre; and (3) for the 120-head-per-hour plant, 150 acres @ $4,800 per acre. These estimates are for raw land serviced by a hard-surfaced road and with track frontage, or with the potential of extending a rail spur to the site. Land costs for similar industrial sites without rail potential would be somewhat less. Treated wastewater discharge by irrigation would significantly increase these land requirements.

2/ These estimates are minimal. Site clearing requiring demolition and removal of existing structures or extensive filling, grading, or piling improvements can increase costs substantially.

3/ Cost estimates for a potable freshwater system can vary widely depending on well depth, well distance from plant site, storage capacity needs, and pressure pumping requirements.

4/ Cost estimates for wastewater treatment can vary widely depending on the type of treatment system selected, year-around weather conditions at the plant site, and other variable factors. These estimates exclude the costs of land for sewage-treatment needs as well as acreage for irrigation purposes and irrigation pumping and spraying equipment.

5/ This fee is based on 6 percent of the construction costs for the building, paved areas, and corrals. Although 6 percent might be considered average, the actual charge normally varies from 5 to 7 percent, reflecting plant size and the extent of work required of the architect. Some clients require more service than others.

APP. TABLE 2--Estimated facility requirements and construction costs of three cattle slaughter plants in 1981.

Facility Area	Construction costs and space requirements by plant size in kill capacity per hour								
	60 Head			90 Head			120 Head		
	Construction cost	Floor area	Total cost	Construction cost	Floor area	Total cost	Construction cost	Floor area	Total cost
	Dollars per sq. ft.	Sq. ft.	Dollars	Dollars per sq. ft.	Sq. ft.	Dollars	Dollars per sq. ft.	Sq. ft.	Dollars
Kill floor	147.90	4,867	719,829.30	140.00	6,935	970,900.00	132.10	8,970	1,184,937.00
Chill cooler 1/	164.30	4,692	770,895.60	155.60	7,490	1,165,069.50	146.80	8,964	1,315,915.20
Sales cooler 1/	164.30	5,472	899,049.60	155.60	7,917	1,231,885.20	146.80	10,527	1,545,361.60
Refrigeration	77.50	800	62,000.00	73.40	1,020	74,868.00	69.20	1,240	85,808.00
Boiler	77.50	442	34,255.00	73.40	490	35,966.00	69.20	540	37,368.00
Hide curing	82.20	3,000	246,600.00	77.80	4,100	318,980.00	73.40	5,500	403,700.00
Rendering	98.60	2,825	278,545.00	93.40	4,040	377,336.00	88.10	5,000	440,500.00
Equipment cleanup	65.70	224	14,716.80	62.20	224	13,932.80	58.70	224	13,148.80
Dry storage	65.70	344	22,600.80	62.20	480	29,856.00	58.70	687	40,326.90
Welfare and cafeteria	65.70	2,296	150,847.20	62.20	2,947	183,303.40	58.70	3,952	231,982.40
Offices 2/	84.50	2,880	243,360.00	80.00	3,600	288,000.00	75.50	4,800	362,400.00
Refrigerated docks 3/	124.40	720	89,568.00	117.80	870	102,486.00	111.20	870	96,744.00
Average or subtotal 4/	123.67 126.00	28,562	3,532,267.30	119.48 120.00	40,113	4,792,582.90	112.30 114.00	51,274	5,758,193.90
Dock aprons	5.40	1,440	7,776.00	5.40	1,740	9,396.00	5.40	1,740	9,396.00
Parking lots	2.88	25,389	73,120.30	2.88	38,502	110,885.80	2.88	52,110	150,076.80
Corrals 5/	35.64	27,800	990,792.00	32.40	39,800	1,289,520.00	29.16	52,300	1,525,068.00
Total 4/	--	83,191	4,603,955.60	--	120,155	6,202,384.70	--	157,424	7,442,734.70

1/ Both the chill and sales coolers for each size plant have sufficient storage-holding capacity for 1 day's kill in each room.

2/ Includes office space for meat inspectors.

3/ Docks are enclosed, insulated, refrigerated, and fitted with insulated doors, dock seals, and bumper guards.

4/ Exclusive of architech's fee, installed refrigeration, and other in-plant equipment. When costs for the building, all in-plant equipment including the refrigeration, and the architect's fee are consolidated into one cost and divided by the amount of floorspace for each size of operation, the cost per square foot of facility amounts to (1) $188.00 for the 60-head-per-hour plant, (2) $181.00 for the 90-head-per-hour operation, and (3) $171.00 for the 120-head-per-hour plant.

5/ Corral cost estimates are based on the amounts of penning areas, alleys, gates, and fencing necessary for each size plant. One-fifth of each plant's corral area is provided with a weathertight roof. Cattle-holding capacities for each plant's corrals are equivalent to 2½ days' kill.

APP.TABLE 3.--Estimated equipment requirements and costs for three sizes of cattle slaughter plants in 1981.[1/]

Equipment	Requirements and costs by plant size in kill capacity per hour		
	60 Head	90 Head	120 Head
Refrigeration:			
Chill cooler - (tons)	125	210	248
Sales cooler - (tons)	30	50	66
Total - (tons)	155	260	314
Refrigeration, installed:			
Per ton - (dollars)	3,250	3,125	3,000
Total - (dollars)	503,750	812,500	942,000
Kill floor, installed - (dollars)	540,000	697,500	846,000
Rendering, installed - (dollars)	720,000	1,096,500	1,440,000
Hide curing, installed - (dollars)	116,700	175,500	233,400
Office, installed - (dollars)[1/]	32,663	48,671	65,098
	1,916,363	2,833,796	3,529,498

1/ Based on information published in Agriculture Handbook No. 513 "Guidelines for Establishing Beef Packing Plants in Rural Areas" with appropriate changes for different plant capacities and updated to indicate cost changes from 1976 to 1981.

APP.TABLE 4 --Estimated land requirements for three sizes of cattle slaughter plants.

Facility area	Requirements by plant size in kill capacity per hour		
	60 Head	90 Head	120 Head
Packing plant (sq. ft.)	27,821	38,722	49,622
Parking lots and dock aprons (sq. ft.)	26,829	40,242	53,850
Cattle corals (sq. ft.)	27,800	39,800	52,300
Sewage treatment lagoons and equipment (sq. ft.)	1,829,520	2,482,920	3,136,320
Land, set aside for other functions[1/] (sq. ft.)	1,355,030	2,320,596	3,241,908
Total estimated land (sq. ft.)	3,267,000	4,922,280	6,534,000
(acres)	75	113	150
Possible irrigation land[2/] (acres)	120	175	230
Total estimated land, including that for irrigation (acres)	195	258	380

1/ Includes land for landscaping, future plant and sewage-treatment expansion, and odor buffer zones around the property.

2/ Where sufficient land is available and climatic conditions are favorable, an alternative to sophisticated and expensive tertiary sewage treatment is discharge of treated wastewaters by irrigation. Additional acreage requirements of this magnitude would serve to reduce per acre average land costs considerably to perhaps $1,000 to $3,400 per acre depending on locality and other site location factors.

APP. TABLE 5--Cost of corral flooring and roofing.

Plant size head per hour	Pens needed 1/ 10' X 20'	Area in pens 2/	Area in alleys 3/	Total area 4/	Cost of pen and alley floor 5/	Gates 6/	Length of Fencing 7/	Cost of gates and fencing 8/	Area covered by weathertight roof 9/	Cost of weathertight roof 10/	Total Cost 11/
		(Square Feet)			(Dollars)	(Number)	(Feet)	(Dollars)	(Square Feet)	(Dollars)	(Dollars)
60	104	20,800	7,000	27,800	38,947	113	3,440	18,687	5,560	15,278	72,912
90	152	30,400	9,400	39,800	55,182	161	4,490	25,133	7,960	21,872	102,187
120	200	40,000	12,300	52,300	72,405	212	5,820	32,760	10,460	30,116	135,281

1/ Based on 11 head per pen with total capacity of approximately 2½ days kill.
2/ Number of pens in Column 2, multiplied by 200 square feet.
3/ Alleys are specified to be 10 feet wide.
4/ Column 3 plus Column 4.
5/ Total area plus the linear length of fence to allow for the 12 inch curbs which separate all pens, plus 3/4 square foot per post, multiplied by $1.25 per square foot.
6/ One gate is allowed for each pen, plus a number of extra ones for the alleys.
7/ Derived from pen requirements.
8/ Fencing cost estimated at $3.61 per linear foot, gates (10 foot wide) estimated at $55.00 each.
9/ One-fifth of total pen area to be covered by weathertight roof.
10/ Square feet of roof multiplied by $2.75 per square foot.
11/ Sum of Columns 6, 9, and 11.

APP. TABLE 6--Annual depreciation, insurance and interest costs for buildings and equipment.

Plant size by head per hour	Building costs 1/	Architectual costs 2/	Total building costs 3/	Building depreciation costs 4/	Total cost of buildings and equipment 5/	Insured value of bldg. & equip. 6/	Annual insurance cost 7/	Annual interest cost 8/	Equipment depreciation cost 9/	Total annual cost 10/
				--- All figures in dollars ---						
60	4,693,955	276,237	4,880,192	195,208	6,796,555	5,437,244	13,593	509,741	86,236	804,779
90	6,202,385	372,143	6,574,528	262,981	9,408,324	7,526,659	18,817	705,624	127,521	1,114,943
120	7,443,735	446,564	7,890,299	315,612	11,419,797	9,135,838	22,840	856,485	158,827	1,353,764

1/ Taken from Table 5 of AH-513 Revision building and paved areas and Corrals.
2/ A figure of 6 percent of total building costs was used.
3/ Column 2 plus column 1.
4/ Column 3 divided by 25 years.
5/ Column 3 plus total equipment cost taken from Table 7 AH-513.
6/ The Oklahoma Inspection Bureau recommended practice is to insure buildings and equipment for 80 percent of their original cost.
7/ An estimated fire and business interruption insurance rate of $0.25 per $100.00 was obtained from the Oklahoma Inspection Bureau, 2000 Classen Building, Oklahoma City, Oklahoma and was applied to column 6.
8/ An interest rate of 15 percent was applied to one-half of column 6.
9/ Taken from Table 7 less 10% salvage over 20 years.
10/ Sum of columns 4, 7, 8 and 9.

APP.TABLE 7 --Annual personal property tax costs for the three plant sizes.

Plant size by head per hour	Assessed real estate value[1/]	Taxes on real estate[2/]	Assessed equipment value[3/]	Taxes on equipment[4/]	Assessed salvage value[5/]	Taxes on equip. salvage value[6/]	Assessed value of cattle inventory[7/]	Taxes on cattle[8/]	Total taxes
		*		*		*	$100/head	*	
60	1,428,957	247,924	603,654	52,367	67,073	11,637	96,000	16,656	328,584
90	1,894,415	328,681	892,646	77,437	99,183	17,208	144,000	24,984	448,310
120	2,239,587	388,568	1,111,792	96,448	123,532	21,433	192,000	33,312	539,761

1/ Twenty-three percent of actual market value of land, buildings, and improvements.
2/ A tax rate of $17.35 per $100 of assessed valuation in Column 2 was used.
3/ Thirty-five percent of actual market value, less the salvage value of the equipment.
4/ Since value of the equipment is being depreciated out over time, a tax rate equal to one-half the tax rate (0.5 times 17.35 = 8.675) per $100 was applied to Column 4.
5/ Thirty-five percent of the salvage value of the equipment.
6/ A tax rate of 17.35 per $100 was applied to the assessed salvage value in Column 6 since salvage value assumed not to depreciate over the life of the equipment.
7/ Personal property tax on cattle is based on an average of the cattle on hand January 1 and December 31 of the tax year, including both live and dressed animals. For the purpose of this study, two days normal kill is assumed to be the average. These cattle are assessed at $100 per head.
8/ A tax of $17.35 per $100 was applied to assessed value of cattle.

APP.TABLE 8 --Annual fixed investment costs

Plant size by head per hour	Depreciation[1/]	Interest[2/]		Insurance[3/]	Taxes[4/]	Total
		Buildings and equipment	Land			
60	281,444	509,741	36,548	13,593	328,584	1,169,910
90	390,502	705,624	47,460	18,817	448,310	1,610,713
120	474,439	856,485	54,000	22,840	539,761	1,947,525

1/ Depreciation was calculated on a straight line method, assuming there would be a 10 percent value at the end of an item's useful life.
2/ Interest was computed at 15 percent of the average investment for capital investment items.
3/ Based on consultations with insurance carriers a rate of $0.72 per $100 of assessed value of insurable items was used.
4/ Taxes were computed on the basis of $17.35 per $100 of the assessed value of the taxable items.

APP. TABLE 9.--Cost components, as a percentage of total annual cost and average cost per head.

Cost Item	Size of plant in head per hour: 60 Head		90 Head		120 Head	
	Percent of annual cost	Cost per head	Percent of annual cost	Cost per head	Percent of annual cost	Cost per head
Annual investment	30.12	9.41	30.19	8.65	29.21	7.86
Depreciation	7.20	2.25	7.29	2.09	7.06	1.90
Interest	13.06	4.08	14.03	4.02	12.75	3.43
Taxes and Insurance	9.86	3.08	8.87	2.54	9.40	2.53
Labor	51.92	16.22	50.23	14.39	49.98	13.45
Kill floor	14.98	4.67	14.80	4.24	15.91	4.28
Supporting operations	15.94	4.98	14.70	4.21	14.20	3.82
Salaried personnel	15.36	4.80	15.01	4.30	14.04	3.78
Tax and welfare	5.64	1.77	5.72	1.64	5.83	1.57
Utilities	5.50	1.72	5.90	1.69	6.17	1.66
Other supplies and services	10.00	3.12	10.89	3.12	11.59	3.12
Interest on operating capital	2.46	0.77	2.79	0.80	3.05	0.82
Total	100.00	31.24	100.00	28.65	100.00	26.91

APP. TABLE 10--Labor requirements for three sizes of cattle slaughter plants.

Occupation	Employees required by plant size in kill capacity per hour1/		
	60 Head	90 Head	120 Head
		(Number)	
Direct labor for -			
Kill floor	33	49	60
Supporting kill floor:			
Hot offal	9	13	18
Cold offal	1	2	2
Cooler	8	10	12
Dock	4	5	5
Rendering	2	3	4
Hide curing	2	3	4
Maintenance	6	8	10
Cleanup	3	4	5
Yard	2	3	3
Total	70	100	123
Salaried personnel -			
General managers	1	1	1
Senior cattle buyers	1	1	1
Beef sales managers	1	1	1
Plant superintendents	1	1	1
Asst. superintendents	1	1	1
Cattle buyers	5	7	10
Beef salesmen	5	7	10
Office managers	1	1	1
Bookkeepers	1	2	4
Payroll and Billing clerks	1	1	1
Secretaries	1	2	3
Switchboard operators	1	1	1
Total	20	26	35
Total labor force	90	126	158

1/ Represents best estimates of the author based on plants studied over a period of years plus consultations with plant managers and other researchers engaged in this type of data collection and analysis.

APP. TABLE 11 --Estimated total cost of labor annually[1/]

Plant size by head per hour	Kill floor[2/]	Supporting Operations[2/]	Salaried Personnel[2/]	Social security tax[3/]	Insurance cost[4/]	Total
60	582,776	621,439	598,970	120,022	101,025	2,024,232
90	793,777	788,161	805,011	160,009	147,018	2,693,976
120	1,068,258	953,445	943,461	197,034	194,827	3,357,025

1/ All labor cost estimates rounded to nearest dollar.
2/ Available data adjusted to reflect current values derived from the 1980 Economic Report of the President (Transmitted to the Congress January 1981).
3/ 1981 rate of 6.65% with maximum wage base of $29,700.
4/ Covers both workman's compensation and general liability costs.

APP. TABLE 12 --Estimated consumption and cost of utilities.[1/]

Plant size by head per hour	Electricity		Gas		Water and sewage treatment		Total cost per year
	Monthly consumption	Yearly cost	Monthly consumption	Yearly cost	Monthly consumption	Yearly cost	
	(KWH)	(Dollars)	($Ft.^3$)	(Dollars)	(1,000 Gallons)	(Dollars)	(Dollars)
60	162,467	93,109	3,612,700	18,064	5,627	103,421	214,594
90	240,289	136,377	5,419,050	27,095	8,441	153,111	316,583
120	311,836	175,848	7,225,400	36,127	11,254	203,076	415,051

1/ Consumption and costs of utilities were computed using data provided by two medium sized cities in New York state, personal communications with utility companies in Washington, DC, and Baltimore, MD, and discussions with plant engineers.

APP. TABLE 13 --Estimated cost of other supplies and services[1/].

Plant size by head per hour	Telephone	Laundry	Miscellaneous supplies	Repair and maintenance	Interest on operating capital	Total[2/]
			-- All figures in dollars --			
60	85,529	71,714	123,155	108,920	95,794	389,318
90	128,296	107,570	184,733	163,380	149,170	583,979
120	171,060	143,060	246,308	217,840	204,523	778,268

1/ These data were synthesized using latest available data updated by applying the appropriate Consumer Price Indes information from the Economic Report of the President, January 1981.
2/ Totals do not include Interest on Operating Capital.

REFERENCES

Bahn, H., and Christensen, R.L. "Regional Self-Sufficiency in Food Production -- the New England States," Journal of the Northeast Agricultural Economics Council, Vol. 8, No. 1. 1979

Business Week "The Livestock Industry's Genetic Revolution," 6/21/82, pp. 124-32

Christensen, R.L. "The Future of Beef Production in New England," Paper presented at the Annual Northeast Agricultural Economics Council Symposium, University of Maryland, Baltimore, Maryland. 1981

Cothern, J.H., Peard, R.M., and Weeks, J.L. "Economies of Scale in Beef Slaughtering - Northern California, 1976," Leaflet 21040, Beef Cattle Economics Series, Division of Agricultural Sciences, University of California, Davis. 1978

Crawford, D.P., Economics of Vertically Integrated Livestock and Meat Operations. Unpublished Master's Thesis, Texas A&M University, College Station, Texas. 1980

Crop Reporting Board. Livestock Slaughter - Annual Summary 1980. Mt. An. 1-2-1, U.S. Department of Agriculture, ESS, Washington, DC. 1981

Crop Reporting Board. Cattle. Lv Gn 1 (1-81), U.S. Department of Agriculture, ESS, Washington, DC. 1981

Crop Reporting Board. Cattle on Feed. Mt. An. 2-1 (1-82), U.S. Department of Agriculture, SRS, Washington, DC. 1982

Editorial Staff,"Monfort: A Meatpacker Tries a Comeback by Trimming Labor Costs," Corporate Strategies, Business Week, New York City, NY. March 1982

Editorial Staff, "Reader Opinions--What are Your Slaughter and Boxed Beef Costs?" Meat Industry, Mill Valley, California. May 1981

Editorial Staff, "Hyplains: How to Slaughter Competitively Next Door to the Giants," Meat Industry, Mill Valley, California. Feb. 1982

Fox, D.G. and Nowak, C.J., "Feeding and Management Strategies for Producing Beef from Holstein Steers on Northeast Dairy Farms," J. Northeastern Agricultural Economics Council, XI (1982): 93-99

Franzmann, J.R. and Kuntz, B.T."Economies of Size in Southwestern Beef Slaughter Plants," Bulletin B-648. Oklahoma State University-Stillwater. 1966

Haas, J.T., Wilkins, P.C., and Roof, J.B., "Marketing Slaughter Cows and Calves in the Northeast," FCS Research Report 36. U.S. Department of Agriculture, FCS, Washington, DC. 1977

Hammons, D.R. "Cattle Killing-Floor Systems and Layouts," Marketing Research Report No. 657 ARS-U.S. Department of Agriculture, in cooperation with Texas Agricultural Experiment Station, Washington, DC. 1970

References, continued

Hammons, D.R., "Cattle Kill-Floor Efficiency," Marketing Research Report No. 1056, ARS-U.S. Department of of Agriculture, Washington, DC. 1976

Hammons, D.R. and Brasington, E.F., "Boxed Beef: A Study of Labor and Packaging in Small-Volume Operations," Summarized Study, Meat Industry, Mill Valley, California. October 1978.

King, S.S. "Dairymen Urge Lower Milk Supports, The New York Times March 13, 1982, p. 2

Lesser, W., Milligan,R., Fox, D., and Knoblauch, W. "The Economic Feasibility of Expanding Fed Beef Production in New York and the Northeast: Summary Report." A.E. Res. 82-18 and A.S. Mimeo 60, Cornell University, April 1982

Logan, S.H. and King, G.A. "Economies of Scale in Beef Slaughter Plants," Giannini Foundation Research Report No. 260. California Agricultural Experiment Station, Giannini Foundation of Agricultural Economics. 1962

McIntosh, K.D. "Characteristics of Livestock Slaughter Plants in Northeastern United States," Bulletin No. 428, Agricultural Experiment Station, West Virginia University, Morgantown, West Virginia. 1959

Milligan, R.A., Nowak, C.J. and Knoblauch, W.A., "Profitability of Feeding Dairy Steers to Feeder and Slaughter Weight on Northeast Dairy Farms," J. Northeastern Agricultural Economics Council XI (1982): 101-109

New York Crop Reporting Service, Cattle, County Estimates. September 1980

Smalley, H.R., Guidelines for Establishing Beef Packing Plants in Rural Areas Ag. Handbook No. 513, U.S. Department of Agricultural, AMS, Beltsville, MD. 1978

Stinson, R.L., Allen, P.G. and Christensen, R.L., "The Economic Feasibility of Constructing Additional Livestock Slaughter Facilities in Massachusetts," R.B. 660, Massachusetts Agricultural Experiment Station, Amherst, Mass. 1978

Tomeo, R.D., The Development of the Wholesome Meat Act of 1967 and its Implications for Meat Inspection and Distribution in Massachusetts, Unpublished Master's Thesis, Department of Agricultural and Food Economics, University of Massachusetts. 1971

Van Arsdall, R.N. and Skold, M.D., "Cattle Raising in the United States," AER No. 235, U.S. Department of Agriculture, ERS, Washington, DC. 1973

Wilson, E., Annual Financial Review of the Meat Packing Industry, 1980, American Meat Institute, Washington, DC. 1981

Wissman, D.J., "Comparative Costs of Slaughtering Cattle in Michigan Packing Plants," Agricultural Economics, Michigan State University, East Lansing, Michigan. 1965