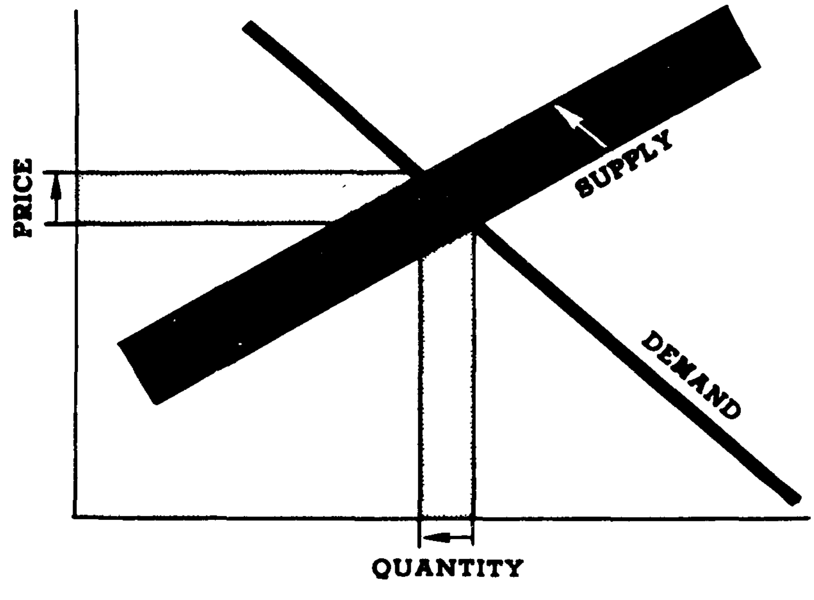
EPA-230/1-73-017
SEPTEMBER, 1973

ECONOMIC ANALYSIS OF PROPOSED EFFLUENT GUIDELINES

MEAT PACKING INDUSTRY



U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Planning and Evaluation
Washington, D.C. 20460

This document is available in limited quantities through the U.S. Environmental Protection Agency, Information Center, Room W-327 Waterside Mall, Washington, D.C. 20460

The document will subsequently be available through the National Technical Information Service, Springfield, Virginia 22151

EPA - 230/1-73-017

ECONOMIC ANALYSIS OF

PROPOSED EFFLUENT GUIDELINES

MEAT PACKING INDUSTRY

Raymond E. Seltzer
James K. Allwood

September, 1973

Prepared for
Office of Planning and Evaluation
Environmental Protection Agency
Washington, D. C. 20460

PREFACE

The attached document is a contractor's study prepared for the Office of Planning and Evaluation of the Environmental Protection Agency ("EPA"). The purpose of the study is to analyze the economic impact which could result from the application of alternative effluent limitation guidelines and standards of performance to be established under sections 304(b) and 306 of the Federal Water Pollution Control Act, as amended.

The study supplements the technical study ("EPA Development Document") supporting the issuance of proposed regulations under sections 304(b) and 306. The Development Document surveys existing and potential waste treatment control methods and technology within particular industrial source categories and supports promulgation of certain effluent limitation guidelines and standards of performance based upon an analysis of the feasibility of these guidelines and standards in accordance with the requirements of sections 304(b) and 306 of the Act. Presented in the Development Document are the investment and operating costs associated with various alternative control and treatment technologies. The attached document supplements this analysis by estimating the broader economic effects which might result from the required application of various control methods and technologies. This study investigates the effect of alternative approaches in terms of product price increases, effects upon employment and the continued viability of affected plants, effects upon foreign trade and other competitive effects.

The study has been prepared with the supervision and review of the Office of Planning and Evaluation of EPA. This report was submitted in fulfillment of Contract No. 68-01-1533, Task Order No. 3 by Development Planning and Research Associates, Inc. Work was completed as of September, 1973.

This report is being released and circulated at approximately the same time as publication in the Federal Register of a notice of proposed rule making under sections 304(b) and 306 of the Act for the subject point source category. The study has not been reviewed by EPA and is not an official EPA publication. The study will be considered along with the information contained in the Development Document and any comments received by EPA on either document before or during proposed rule making proceedings necessary to establish final regulations. Prior to final promulgation of regulations, the accompanying study shall have standing in any EPA proceeding or court proceeding only to the extent that it represents the views of the contractor who studied the subject industry. It cannot be cited, referenced, or represented in any respect in any such proceeding as a statement of EPA's views regarding the subject industry.

CONTENTS

CONTENTS (continued)

CONTENTS (continued)

CONTENTS (continued)

ECONOMIC ANALYSIS
OF
PROPOSED EFFLUENT GUIDELINES

MEAT PACKING INDUSTRY

I. INDUSTRY SEGMENTS

In an earlier study, "Initial Analysis of the Economic Impact of Water Pollution Control Costs Upon the Meat Industry," completed in November, 1972 for the Environmental Protection Agency by Development Planning and Research Associates, Inc., preliminary estimates were made of the impact of water pollution controls proposed at that time.

The purpose of this report is to review new effluent guidelines being proposed by the Environmental Protection Agency, to evaluate the impact of the new guidelines on the meat packing industry and to update, expand and improve upon the earlier analysis.

This analysis is concerned with meat packing plants and slaughter houses (SIC 2011) and includes the following types of plants:

1. Meat packinghouses - Slaughter livestock and process meat and meat products.

2. Slaughter houses - Slaughter livestock but do no processing.

The analysis will be limited to beef and pork operations. The slaughter of calves (1.5%) and sheep and lambs (1.8%) constitutes but a small part of the total volume of livestock slaughtered, and since adequate data on slaughter costs for these species are unavailable, consideration of calf and sheep and lamb slaughter has been omitted from this study. However, it is not believed that this omission will significantly influence the results of the analysis.

Within the meat packing industry, there exists a variety of firm and plant situations which will have a bearing on the degree to which individual plants may be affected by proposed effluent control requirements.

Conditions which would influence the impact of water pollution controls on firms would include the following:

* Types of firms and plants
* Size of firms and plants
* Level and direction of integration
* Degree of specialization
* Number and location of plants
* Level of technology and efficiency of plants
* Employment
* Concentration of ownership of plants and of production

Types of Firms and Plants

Multiple vs Single-Plant Firms

The meat packing industry is characterized by a preponderance of single-plant firms. The number of firms and number of plants as reported by the Census of Manufactures, 1947-1967 was as follows:

Year	Number of Firms	Number of Plants	Ave. Plants per Firm
1947	1,999	2,154	1.08
1954	2,228	2,367	1.06
1958	2,646	2,810	1.06
1963	2,833	2,992	1.06
1967	2,529	2,697	1.06

As shown above, the relationship between the number of firms and the number of plants has been relatively constant over the past 15 years.

Information on ownership of federally-inspected meat packing plants, which account for 90 percent of total commercial slaughter indicates the following distribution among single-plant and multiple-plant firms in 1972:

Type of Firm	No. Firms	% of Total	No. Plants	% of Total
Single plant	836	96.3	836	85.2
2 plants	15	1.7	30	3.1
3 plants	6	0.7	18	1.8
4 - 9 plants	7	0.8	39	4.0
10 or more plants	4	0.5	58	5.9
Total	868	100.0	981	100.0

These data are restricted to those meat packinghouses and slaughter plants which kill livestock. In addition, many firms also own specialized processing plants, which do no killing.

Size of Firms

Due to the fact that 96 percentage of the firms represented by the Federally-inspected plants and virtually all of the State-inspected firms are single plant firms, size distribution among firms is closely related to size distribution among plants. However, multiple-plant firms are generally, but not always, larger than single plant firms. In recent years, many of the major meat packers have been acquired by conglomerates (e.g. Armour acquired by Greyhound, Wilson acquired by LTV Corp., Morell acquired by AMK Corporation) and some have become conglomerates themselves through acquisition and diversification (e.g. Swift and Company, now ESMARK). However, the Packers Consent Decree (1920) limits the extent to which meat packers can acquire ownership in closely related businesses.

Meat packing generates a high dollar value of sales. Thirteen meat packing companies appear in "Fortune's" list of the 500 largest industrial corporations in the United States. However, the sales volume reported includes all products (meat and others) sold by these firms. Five out of the ten highest firms in terms of sales per employee were meat packers, and only the fact that several of the major packers are parts of conglomerates keep the meat packers from dominating this category. The same situation exists in terms of sales per dollar of stockholder's equity, where six of the top ten firms were independent meat packers.

Concentration of Ownership

When value of shipments is analyzed by company ownership, an indication of the concentration in the industry is seen. Out of the 2,697 plants reported by the 1967 Census, 350, or 13 percent, were owned by multi-unit companies. However, these multi-unit companies accounted for a high percentage of the total value of shipments by the industry.

Table I-1 shows the percent of total value of shipments accounted for the largest companies for census years, 1947-1967.

Table I-1. Concentration in the meat packing industry, percent of shipments accounted for by the largest companies 1/

Year	No. Companies	Value of Shipments: Total (million) Dollars	Percent accounted for by: 4 largest companies	8 largest companies	20 largest companies	50 largest companies
1967	2,529	2,220.5	26	38	50	62
1963	2,833	1,908.3	31	42	54	64
1958	2,646	1,677.1	34	46	57	65
1954	2,228	1,394.5	39	51	60	NA
1947	1,999	977.1	41	54	63	NA

1/ Source: U.S. Department of Commerce, Census of Manufactures, 1967.

These data show that the importance of the four leading packers decreased from 41 percent to 26 percent of total shipments, a loss of 15 percent 1947-1967. The eight largest decreased 18 percent and the 20 largest decreased 13 percent. This indicates that most of the loss apparently occurred in the "big 4" and that certain firms in the 20 largest group gained rather than lost during the period. However, there is still a high degree of concentration in the meat packing industry since the 20 largest companies (out of a total of 2,529 firms) produced 50 percent of the total value of shipments in 1967.

Level of Integration

Horizontal integration is common in the meat packing industry. Although the majority of firms, by number, are single-plant firms, those firms which do have multiple-plant operations have extended their operations horizontally through establishing new plants which perform essentially the same killing and processing functions. However, these plants may, in some instances, be specialized in terms of slaughter and/or processing operations. The plants normally operate as separate cost centers within the overall corporate organization.

Vertical integration can be either forward toward the consumer or backward toward the suppliers. Meat packers have traditionally integrated forward through the wholesaling function although there exists, at the same time within the meat industry, independent meat wholesalers and meat jobbers. Prior to 1920, packers were becoming involved in the operation of a variety of related businesses. However, in 1918 the "big" packers came under fire from the newly created Federal Trade Commission and in February 1920, the 5 major companies signed the now-famous "Packers Consent Decree". The concessions agreed to by the companies included the sale of their holdings in stockyards, terminal railroads, cold-storage warehouses, and market newspapers; also they agreed to discontinue or refrain from handling a long list of non-meat products, including fresh milk or cream and to operate no retail meat markets in the United States. The "Consent Decree" thus limited the ability of packers to integrate toward retail meat sales or to acquire and operate businesses closely related to their industry.

Packers have integrated back toward the producer by feeding cattle for their own account, usually in commercial custom feedlots. Packers contend that such feeding operations contribute to efficiency in the slaughtering operation by providing a regular source of supplies on Monday mornings before supplies can be obtained, or by countering seasonally short supplies in certain areas. However, cattle feeders see an upward trend in packer-feeding as s shift of livestock feeding out of traditional agricultural enterprise into a vertically-integrated production process such as has occurred in the broiler industry. They also fear that packers may use ownerership of cattle on feed as a price hedge, or as a device to depress prices as they negotiate for additional animals in the market. Packer feeding tends to vary with market conditions, and since 1954 has ranged between 4 and 8 percent of total fed marketings of cattle. However, if feeding by "associated interests", including separate feeding by owners, directors, officers, employees, non-reporting subsidaries and affiliates of packers is included, "packer fed" cattle may account for 8 to 12 percent of total fed cattle marketings. A study "Packer Feeding of Cattle" published by the Packers and Stockyards Division, Consumer and Marketing Service, U.S. Department of Agriculture, in 1966, concluded that feeding of cattle by packers and associated interests could have a significant depressive effect on prices on specific markets, but that such feeding would not significantly affect the overall level of prices in a competitive market situation.

Size of Plants

For the purposes of this study, meat packers and specialized slaughter plants were classified into three size groups: large - 200 million pounds or greater annual liveweight killed, medium - 25 million to 200 million pounds and small - 300 thousand pounds to 25 million pounds.

A special tabulation of federally-inspected plants, by size category, was prepared for this project by the Statistical Reporting Service, U.S. Department of Agriculture. This distribution by plant size by state, is shown in Table I-2 In order to avoid disclosure of the identity of individual plants, it was necessary to combine plant classifications in 18 states. However, the totals, by size group, for the United States, are correct as of August, 1971. Plant distribution, by size, for the U.S. in August, 1971 was as follows:

Size	Federally-Inspected	Non-Federally Inspected	Total
Large	84	-	84
Medium	309	-	309
Small	437	3,163	3,600

Large plants are concentrated in Iowa (21), Nebraska (10), Kansas (5), Colorado(5), Minnesota (5), Illinois (4), Wisconsin (4), Missouri (4), Indiana (3) and Texas (3); these 10 states accounting for 64 out of the total of 84 large plants. States having large numbers of small plants, most of which are state-inspected, include Minnesota (280), Pennsylvania (234), Ohio (212), Illinois (194), Texas (192), Iowa (182), Indiana (175), Michigan (172), Kansas (133), Wisconsin (110), and New York (103).

A substantial percentage of these small plants are frozen food lockers which kill and process livestock for their customers.

Table I-2. Federally-inspected meat packing plants, distribution by size, by state, Aug., 1971.

State	Number of Plants			
	Federally-inspected 1971			State-inspected 1970
	Large[1/]	Medium[2/]	Small[3/]	Small
New England[4/]	-	4	10	43
N. Y.	-	8	26	77
N. J.		6[5/]	6	16
Pa.		11[5/]	14	220
Ohio		16[5/]	23	189
Ind.	3	5	8	167
Ill.	4	17	15	179
Mich.		9[5/]	6	166
Wisc.	4	9	5	105
Minn.	5	8	25	255
Iowa	21	18	8	174
Mo.	4	5	13	54
N. Dak.	-		29[5/]	49
S. Dak.		8[5/][6/]		33
Nebr.	10	21	14	57
Kans.	5	12	13	120
Del.-Md.-D.C.	-		8[5/]	46
Va.		7[5/]	12	21
W. Va.	-	-	[7/]	43
N. C.	-	4	9	78
S. C.	-		5[5/]	55
Ga.	-	8[6/]		87
Fla.	-	8[6/]		40
Ky.		4[5/]	18	40
Tenn.	-	8[5/]	7	57
Ala.	-		5[5/]	58
Miss.		5[5/]	-	48
Ark.	-	4	4	49
La.	-	3	4	89
Okla.		4[5/]	7	64
Tex.	3	37	36	156
Mont.	-		27[5/]	30
Idaho	-	4	4	48
Wyo.	-	-	[7/]	11
Colo.	5	8	10	38
N. Mex.	-	4	9	8
Ariz.			[7/]	16
Utah	-	3	7	39
Nev.	-	-	[7/]	5
Wash.	-	8	14	28
Ore.	-	5	7	66
Calif.		40[5/]	27	19
Haw.	-	-[7/]	-	19
All Other	20	17	18	-
Total	84	309	437	3,163

1/ Over 200 million lbs. annual liveweight kill.
2/ 25 Million lbs. through 199 million lbs. annual liveweight kill.
3/ Less than 25 million lbs. but over 300 thousand pounds annual liveweight kill.
4/ New England includes Me., N.H., Vt., Mass., R.I., Conn.
Notations: dash (-) indicates none
5/ Plants from larger size group included to avoid disclosing individual operations.
6/ Plants from smaller size group included to avoid disclosing individual operations.
7/ Arizona, Hawaii, Nev., W. Virginia and Wyo. combined to avoid disclosing individual operations.

Number and Location of Meatpacking Plants

The number of meat packing and slaughter plants and the characteristics of the composite of plants which represents the industry changes constantly over time. Estimate of plant numbers and analyses of the characteristics of plants in the industry are made periodically by various agencies of the U. S. Department of Agriculture. Certain estimates, e.g., number of slaughter plants by species slaughtered, are made only every five years. Other data, e.g., number of livestock slaughtering establishments, are published on an annual basis, March 1 of each year. In addition, certain special tabulations are made at other intervals, e.g., distribution of plants by size, August, 1971. As a result, data regarding all characteristics of the industry are not available as of a single point in time and it is impossible to reconcile the individual point estimates to provide an estimate on all industry characteristics at any specific single date.

Although this situation makes direct comparisons of plant numbers and plant characteristics difficult, the data are consistent and reflect changes which are continuing to occur over time.

There were 5,991 livestock slaughtering plants in the United States as of March 1, 1973, down from 6,156 in 1972 and 6,400 in 1971 (Table I-3). In contrast to the steady decline in the number of slaughter plants, there has been a rapid increase in the number of Federally inspected plants as inspection requirements have been more vigorously enforced. The number of Federally inspected plants rose from 766 in 1971 to 1,364 in 1973. The increase in Federally inspected plants and the decrease in total number of plants are related in that enforcement of inspection standards forced the closure of many plants.

In terms of the total number of slaughtering plants, the 10 leading states, March 1, 1973 were as follows:

Rank	State	No. Plants
1	Texas	561
2	Pennsylvania	492
3	Iowa	365
4	Ohio	316
5	Minnesota	275
6	Missouri	275
7	Illinois	249
8	Wisconsin	228
9	Nebraska	205
10	Kansas	204

Distribution of Federally-inspected slaughter plants as of March 1, 1973 among the ten leading states was:

Rank	State	No. F.I. Plants	% of Total Plants
1	Pennsylvania	336	68
2	Missouri	125	45
3	Nebraska	80	39
4	Texas	75	13
5	California	63	82
6	Oregon	57	90
7	Minnesota	48	17
8	Iowa	45	12
9	Kentucky	44	42
10	North Dakota	37	41
	Other states	454	13
	Total U. S.	1,364	23

Table I-3. NUMBER OF LIVESTOCK SLAUGHTERING ESTABLISHMENTS, MARCH 1, 1971, 1972 and 1973

State	Under Federal Inspection			Other			Total		
	1971	1972	1973	1971	1972	1973	1971	1972	1973
New England	14	17	20	130	83	94	144	100	114
New York	33	35	32	110	98	90	143	133	122
New Jersey	12	12	11	37	36	36	49	48	47
Pennsylvania	25	26	336	391	387	156	416	413	492
Ohio	39	40	36	265	294	280	304	334	316
Indiana	14	15	15	202	190	165	216	205	180
Illinois	34	38	34	235*	215	215	269	253	249
Michigan	13	16	17	174	171	164	187	187	181
Wisconsin	18	19	18	217	218	210	235	237	228
Minnesota	16	67	48	323	249	227	339	316	275
Iowa	45	48	45	353	340	320	398	388	365
Missouri	23	25	125	350	282	150	373	307	275
North Dakota	43	40	37	64*	62	53	107*	102	90
South Dakota	8	8	7	113	113	90	121	121	97
Nebraska	34	102	80	188	105	125	222	207	205
Kansas	25	31	27	186	176	177	211	207	204
Delaware - Maryland	8	10	9	72	70	54	80	80	63
Virginia	20	22	21	66	78	70	86	100	91
West Virginia	1	1	2	74	69	61	75	70	63
North Carolina	13	14	12	98	96	106	111	110	118
South Carolina	4	5	5	58	56	54	62	61	59
Georgia	7	8	8	154	138	132	161	146	140
Florida	8	8	6	49	53	52	57	61	58
Kentucky	18	48	44	109	60	60	127	108	104
Tennessee	15	16	16	139	128	116	154	144	132
Alabama	6	6	7	72	91	100	78	97	107
Mississippi	5	7	8	116	105	84	121	112	92
Arkansas	9	9	7	64	62	60	73	71	67
Louisiana	5	7	7	224	205	174	229	212	181
Oklahoma	11	12	13	176	164	179	187	176	192
Texas	73	76	75	425	415	486	498	491	561
Montana	5	29	30	48	19	16	53	48	46
Idaho	8	8	8	47	48	49	55	56	57
Wyoming	1	1	1	24	28	25	25	29	26
Colorado	24	23	23	59	61	52	83	84	75
New Mexico	16	16	14	15	16	15	31	32	29
Arizona	5	5	5	27	26	27	32	31	32
Utah	9	10	10	40	38	36	49	48	46
Nevada	1	2	2	5	5	5	6	7	7
Washington	21	21	22	23	23	20	44*	44	42
Oregon	12	12	57	70	64	6	82	76	63
California	64	68	63	20	14	14	84	82	77
48 States	765	983	1,363	5,612	5,151	4,605	6,377	6,134	5,968
Hawaii	1	1	1	22	21	22	23	22	23
U. S.	766	984	1,364	5,634	5,172	4,627	6,400	6,156	5,991

* Revised.

Substantial differences in the proportion of Federally-inspected plants exist among states. Oregon has 90 percent Federally-inspected, California 82 percent and Pennsylvania 68 percent. At the low end, West Virginia has only three percent of its slaughter plants Federally-inspected and Louisiana and Wyoming have four percent each.

Pounds of liveweight killed is the best indicator of the total volume of meat packing in a given state. The ten leading states, for each species killed and for total kill, in 1972 are shown in Table I-4.

In terms of total slaughter, Iowa dominates the industry, ranking first in hog slaughter and second in cattle slaughter with a total annual kill in 1972 of over 10 billion pounds liveweight. Nebraska ranks second overall with an annual kill of 5.7 billion pounds of which 5.0 billion was represented by cattle slaughter alone. Texas kills 3.9 billion pounds--3.2 billion from cattle. California, Kansas, Illinois, Colorado and Minnesota follow in order with annual kills of 3.0 to 3.4 billion and Wisconsin and Ohio kill about 2.0 billion pounds annually. Slaughter of calves is concentrated in the South and East and slaughter of sheep and lambs in the West and Southwest.

Geographic Distribution--Meat packing plants are found in every state. Two factors govern their location: (1) concentration of fed livestock for slaughter and (2) concentration of market demand. The trend in recent years has been away from major population centers toward areas having high densities of fed livestock. Figures I-1, 2 and 3 show the number and location of slaughter plants as of March 1, 1970.

Multiple vs. Single Species Plants

The number of plants slaughtering various combinations of livestock is shown by states in Table I-5. Most plants are multiple-species plants, as shown by the following summary:

	March, 1970	
Species Killed	No. Plants	% of Total
Cattle, calves, hogs	1,557	40.0
Cattle, calves, hogs, sheep & lambs	1,477	38.0
Cattle and calves only	465	12.0
Cattle, calves, sheep & lambs	206	5.3
Hogs only	169	4.3
Sheep and lambs only	13	0.3
Hogs, sheep and lambs	2	0.1
Total	3,889	100.0

Table I-4. Ranking states in meat packing, by species and total, 000 pounds liveweight killed, 1972.

Rank	Cattle		Hogs		Calves		Sheep & Lambs		Total Kill	
	State	Kill	State	Kill	State	Kill	State	Kill	State	Kill
		(000 lbs.)		(000 lbs.)		(000 lbs.)		(000 lbs.)		(000 lbs.)
1	Neb.	5,007,117	Iowa	5,066,360	La.	94,675	Colo.	211,553	Iowa	10,042,899
2	Iowa	4,898,258	Ill.	1,561,854	Texas	93,567	Calif.	186,825	Neb.	5,744,857
3	Texas	3,214,816	Minn.	1,244,831	N. Dak.	82,404	Texas	143,156	Texas	3,928,249
4	Calif.	2,830,246	Mich.	940,060	N. Y.	69,792	Neb.	96,299	Calif.	3,405,070
5	Kans.	2,657,005	Ohio	922,411	S. Car.	57,311	N. J.	64,517	Kans.	3,188,434
6	Colo.	2,642,532	Ind.	914,679	Calif.	46,211	Utah	56,207	Ill.	3,117,793
7	Minn.	1,635,620	Pa.	893,892	Wisc.	39,514	Iowa	48,443	Colo.	3,087,782
8	Ill.	1,492,812	Wisc.	778,267	Tenn.	35,609	Ill.	45,967	Minn.	2,906,349
9	Wisc.	1,242,415	Va.	719,170	Pa.	34,641	S. Dak.	44,647	Wisc.	2,060,542
10	Ohio	1,094,925	Tenn.	691,187	Iowa	29,838	Mich.	41,588	Ohio	2,033,246

Source: Livestock Slaughter, Annual Summary, 1972, SRS, USDA.

Table I-5. Number of livestock slaughter plants 1/ by species slaughtered, by States, March 1970

State 2/	Plants slaughtering							
	Cattle and calves, hogs and sheep and lambs	Cattle and calves only	Cattle and calves and hogs	Cattle and calves and sheep and lambs	Hogs only	Hogs and sheep and lambs	Sheep and lambs only	Total
	Number							
N. Eng.	29	7	3	14	3	--	--	56
N. Y.	67	16	6	20	4	--	--	113
N. J.	9	3	1	11	3	--	--	27
Pa.	50	56	98	31	11	--	--	246
Ohio	101	29	54	26	17	--	1	228
Ind.	9	17	142	8	5	--	--	181
Ill.	146	18	34	2	12	--	2	214
Mich.	107	24	15	19	11	--	--	176
Wis.	71	15	31	6	3	--	--	126
Minn.	99	12	158	1	2	--	--	272
Iowa	35	23	142	--	15	--	--	215
Mo.	34	11	23	2	6	--	--	76
N. Dak.	29	1	21	1	--	--	--	52
S. Dak.	27	4	9	--	2	--	--	42
Nebr.	31	28	30	1	--	--	1	91
Kans.	67	14	59	1	1	--	--	142
Del.-Md.	18	6	15	13	2	--	--	54
Va.	19	--	16	2	4	--	--	41
W. Va.	14	2	23	2	3	--	--	44
N. C.	13	5	60	--	11	--	--	89
S. C.	8	2	45	--	2	--	--	57
Ga.	5	3	78	--	7	--	--	93
Fla.	15	9	20	1	3	--	--	48
Ky.	12	5	29	1	4	--	2	53
Tenn.	25	2	33	2	9	--	--	72
Ala.	5	1	53	--	6	--	--	65
Miss.	--	4	49	--	1	--	--	54
Ark.	2	4	49	--	3	--	--	58
La.	23	14	54	--	1	--	--	92
Okla.	4	15	51	2	3	--	--	75
Texas	57	26	127	5	7	--	1	223
Mont.	25	2	6	3	--	--	--	36
Idaho	52	5	1	--	--	--	--	58
Wyo.	11	--	2	--	--	--	--	13
Colo.	37	12	5	4	3	--	--	61
N. Mex.	20	2	1	1	--	2	3	29
Ariz.	12	6	3	1	--	--	--	22
Utah	42	2	2	1	--	--	1	48
Nev.	5	1	--	--	--	--	--	6
Wash.	33	10	5	4	--	--	1	53
Oreg.	70	5	1	4	--	--	--	80
Calif.	35	34	1	16	1	--	1	88
48 States ...	1,474	455	1,555	205	165	2	13	3,869
Hawaii	3	10	2	1	4	--	--	20
U. S. Total...	1,477	465	1,557	206	169	2	13	3,889

1/ Classified as to species slaughtered in 1969. Includes all Federally inspected plants plus all plants not under Federal inspection with an output of 300,000 pounds or more live weight annually.
2/ New England includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut. Commercial slaughter not estimated in Alaska.

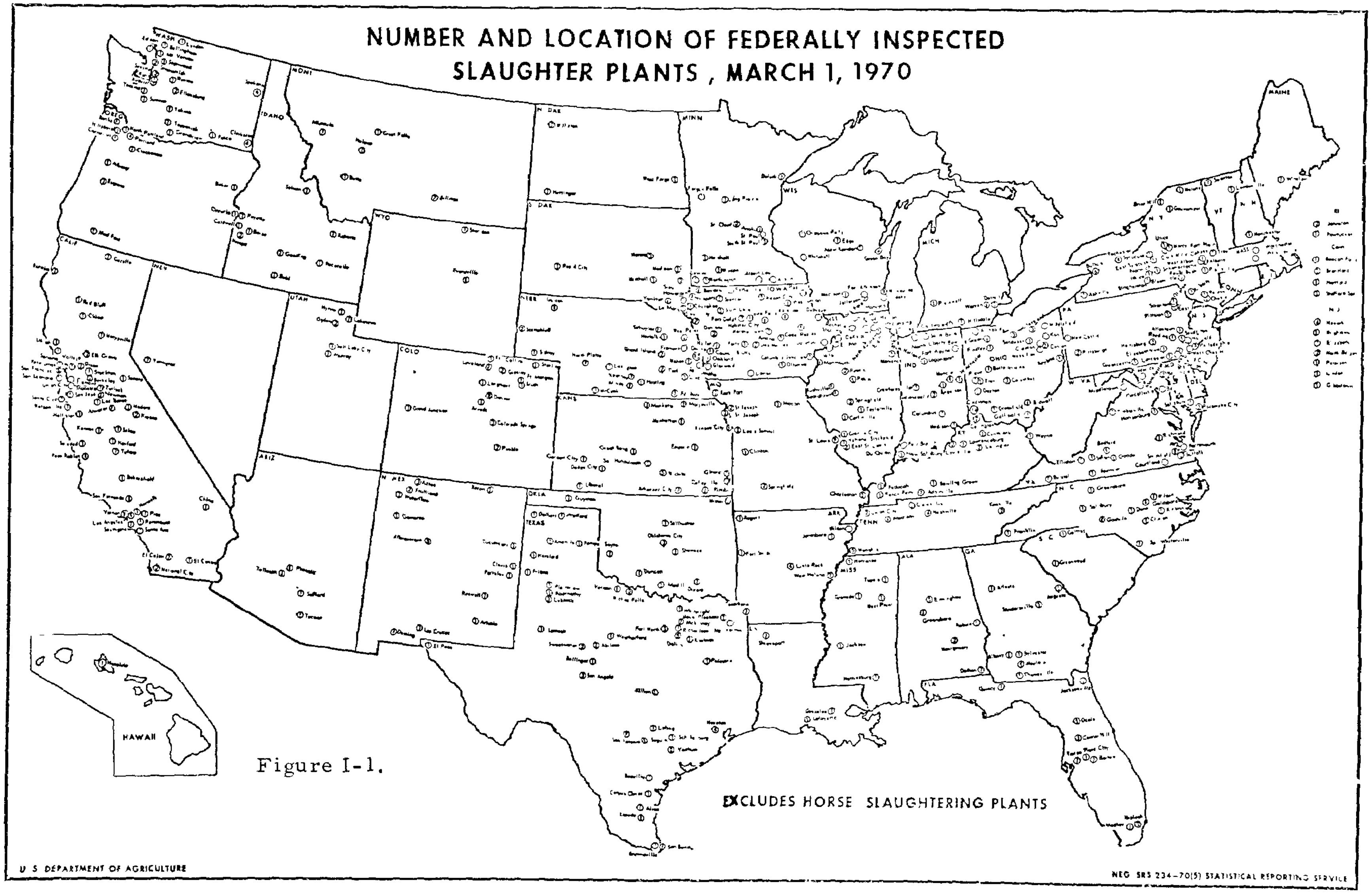

NUMBER AND LOCATION OF FEDERALLY INSPECTED
SLAUGHTER PLANTS, MARCH 1, 1970
EXCLUDES HORSE SLAUGHTERING PLANTS
HAWAII
U S DEPARTMENT OF AGRICULTURE
NEG SRS 234-70(5) STATISTICAL REPORTING SERVICE

Figure I-1.

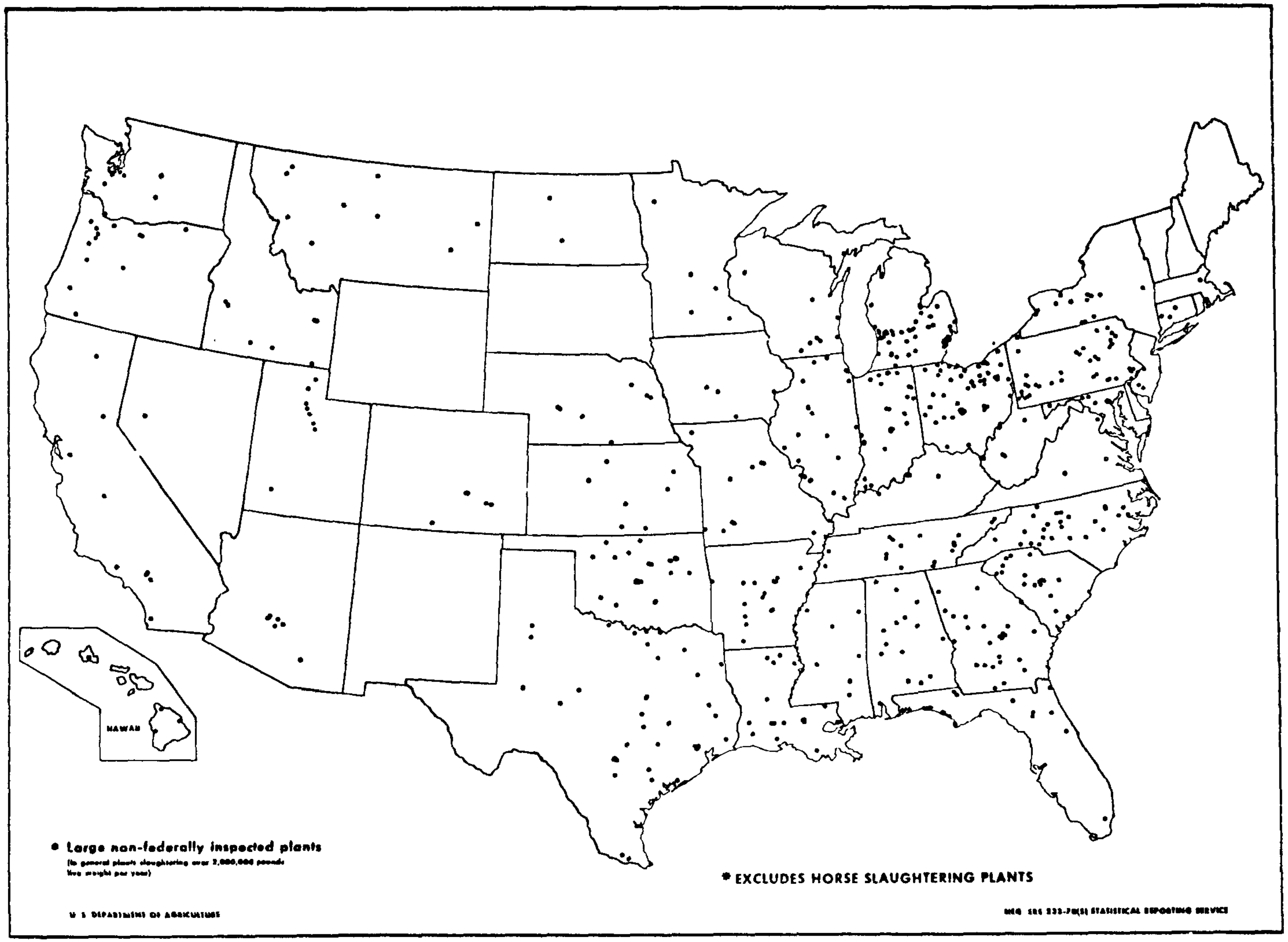


Figure I-2. Non-federally inspected livestock slaughtering plants,* slaughtering over 2,000,000 pounds annually.

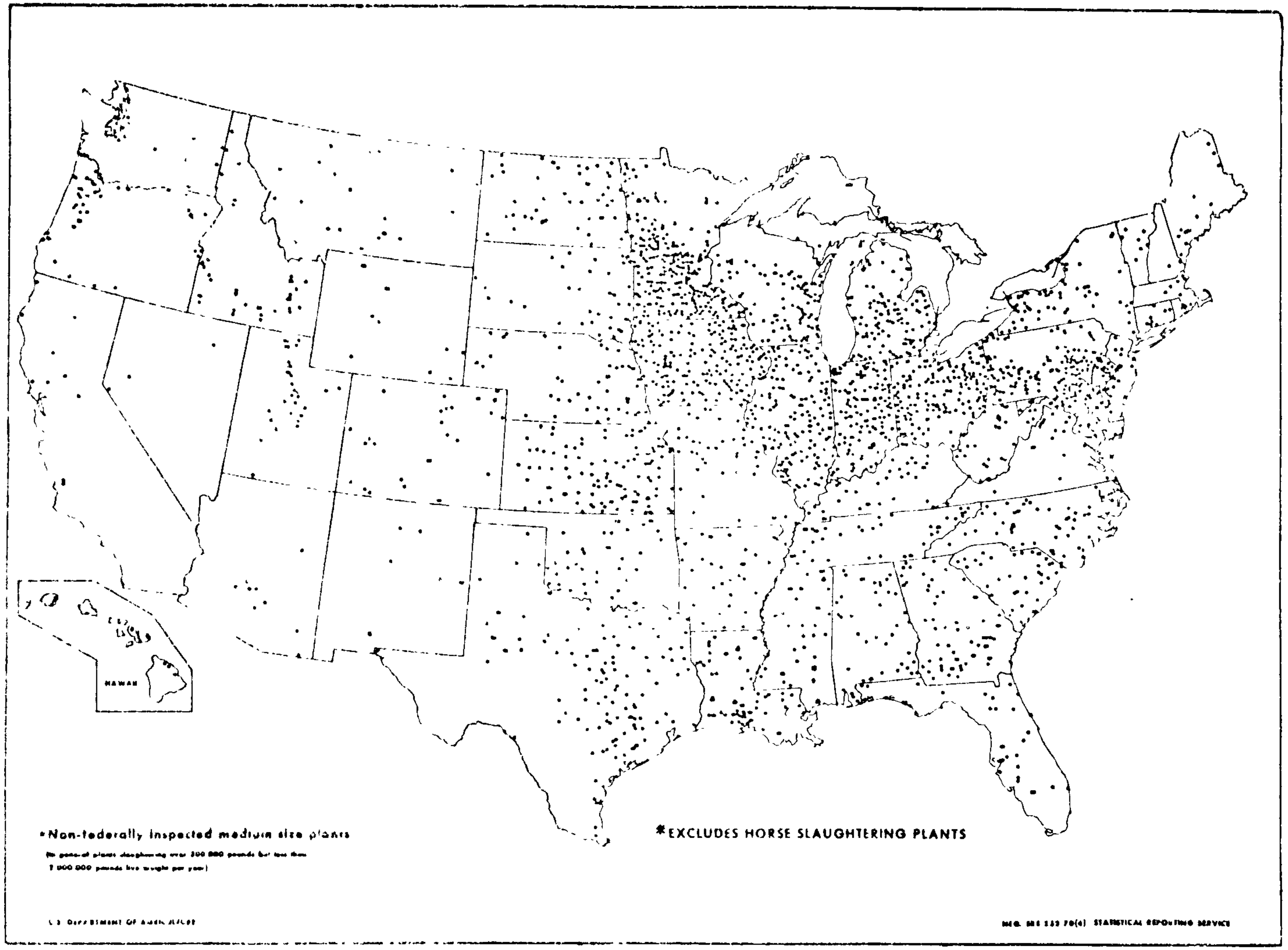


Figure I-3. Non-federally inspected livestock slaughtering plants,* March 1, 1970 slaughtering between 300,000 and 2,000,000 pounds annually.

Estimated Number of Plants Slaughtering Over 2,000,000 Pounds Annually

In an effort to restrict the analysis to "commercial" packinghouses, a decision was made to consider only those plants slaughtering more than 2 million pounds live weight annually. This volume of slaughter is equivalent to an average slaughter of seven 1,040-pound steer per day for a 260 day working year. This is a very small plant and would represent a lower limit to a "commercial" slaughter operation.

Based on reported distribution by plant size as estimated by the USDA in 1970, and analysis of plant types from current lists of Federally-Inspected slaughter plants, plus 1973 USDA reports of the number of livestock slaughtering plants, Federally-Inspected and other, and historical trends in the industry, estimates were made of the number of slaughter plants, by type and size for 1973. Projections were made of demands for meat 1973-1983, taking into account both population growth and income-induced expansion in demands. Considering historical and projected size distribution among plants, the number and size of plants required to meet slaughter demands on plants with annual kill in excess of 2 million pounds was calculated. These plant numbers were used as the baseline case--representative of the number of plants assuming levels of effluent control presently prevailing in the industry. Reductions in plant numbers resulting from the imposition of pollution controls were measured against this base. These baseline numbers are given in Table I-6.

Table I-6. Estimated number of meat packing and slaughter plants, by size and type, baseline effluent treatment level, 1973, 1977, and 1983.

Type and Size of Plant	Number of Plants		
	1973	1977	1983
Meat packinghouses			
Large and extra large	85	135	195
Medium	305	307	310
Small	750	695	640
Slaughterhouses			
Large and extra large	22	30	35
Medium	80	68	55
Small	178	144	110
Total number of plants with over 2 million lbs. LWK/Yr.	1,420	1,379	1,345

Very Small Meat Packing and Slaughter Plants

The economic impact analysis, which follows in this report, has been focused on those plants which slaughter in excess of two million pounds liveweight annually. In addition to the 1, 420 plants estimated to fall in this "commercial" category in 1973, there are approximately 2, 000 very small meat packers and slaughterers plus an estimated 2, 600 frozen food locker plants which slaughter for their patrons.

These very small packers and slaughterers include retail butchers who slaughter, custom slaughterers, institutions (universities, prisons, etc.) and very small packers. Although there are large numbers of such slaughterers, their individual volume is small and in the aggregate they account for less than two percent of the total volume of livestock slaughtered annually.

These plants are located mainly in small communities. It is estimated that half of these small killers may be discharging into municipal sewer systems. The status of effluent disposal for the remaining plants is unknown.

Frozen Food Locker Plants

Frozen food locker plants exist in every state. Although their primary function is to rent frozen food storage space to their patrons, many do custom killing of livestock and process sausage and other meat products as a service to their customers.

The Farmer Cooperative Service, USDA estimates that there are approximately 6.500 locker plants in the United States. The estimated geographic distribution of these plants is shown in Table I-7. Locker plants are most numerous in the Midwest and Great Plains.

The ten leading states, in terms of number of frozen food locker plants, are as follows:

State	No. Plants
Iowa	656
Minnesota	407
Wisconsin	380
Illinois	363
Texas	361
Kansas	347
Missouri	324
California	273
Ohio	263
Indiana	249

Table I-7. Estimated Number of frozen food locker plants, by state, 1972[1/]

State	No. Locker Plants	State	No. Locker Plants
Alabama	52	Montana	100
Alaska	12	Nebraska	330
Arizona	22	Nevada	5
Arkansas	75	New Hampshire	9
California	273	New Jersey	26
Colorado	117	New Mexico	29
Connecticut	12	New York	77
Delaware	9	North Carolina	72
Florida	41	North Dakota	168
Georgia	91	Ohio	263
Hawaii	3	Oklahoma	187
Idaho	122	Oregon	108
Illinois	363	Pennsylvania	172
Indiana	249	Rhode Island	5
Iowa	656	South Carolina	29
Kansas	347	South Dakota	151
Kentucky	60	Tennessee	65
Louisiana	22	Texas	361
Maine	9	Utah	72
Maryland	14	Vermont	26
Massachusetts	14	Virginia	27
Michigan	170	Washington	247
Minnesota	407	West Virginia	14
Mississippi	53	Wisconsin	380
Missouri	324	Wyoming	60
		Total	6,500

[1/] Estimated from analysis of membership of National Institute of Locker and Freezer Provisioners and from estimates of the Farmer Cooperative Service, U.S.D.A.

Slaughtering and Meat Processing - Approximately 40 percent (2600 plants) slaughter livestock as a service to their members and over 90 percent process meat and poultry. [1/] Thirty percent buy livestock for slaughter and resale to their customers and 65 percent sell packer-slaughtered meat in wholesale cuts. Ninety percent (included in processing) cut, wrap and freeze meats on a custom basis.

However, in terms of volume of livestock slaughtered, locker plants are relatively insignificant. The average plant slaughters less than 1000 head of cattle and calves annually. Assuming that slaughter was 60 percent hogs and 40 percent cattle (by number), the total annual liveweight kill of an average locker plant would be approximately a half million pounds per year. The 2,600 plants would account for slightly over 2 percent of total U.S. slaughter in 1972.

Effluent Disposal - No information is available concerning the current status of effluent disposal by locker plants slaughtering livestock. Locker plants normally would use more dry clean up practices than would meat packers who have steam available for equipment cleaning. The principal pollutants in the effluents of locker plants would be blood and wash waters. Those locker plants located in towns and cities having adequate municipal sewage disposal systems, normally discharge their liquid wastes into sewers. Plants located in rural areas and in small towns may dump their effluents into streams or use other ground disposal systems, with or without pretreatment. Some plants have lagoon systems although the number of such systems is not known.

Distribution of locker plants, by size of town in which located, in 1965, was as follows:

Population of Town	Percentage of total no. plants
1,000 and under	36
1,001 - 5,000	33
5,001 - 10,000	9
10,001 - 25,000	10
Over 25,000	12

[1/] Seymour, William R. and Bert D. Miner, "An Appraisal of Frozen Food Locker and Freezer Provisioning Cooperatives, 1965," General Report 139, Farmer Cooperative Service, U.S.D.A.

Employment in the Meat Packing Industry

Employment in the meat packing industry has been dropping during the past decade as new, more highly automated plants and more efficient processing systems have increased the productivity of plant labor.

Year	All employees	Production workers
	(000)	(000)
1954	220.2	167.8
1958	201.2	150.9
1963	181.0	138.8
1967	170.5	130.8

Source: U.S. Department of Commerce - Census of Manufactures.

Approximately 77 percent of all employees in the meat packing industry are classified as "production" workers. This is substantially above the average for all food industries where production workers represent approximately 66 percent of total employment.

Selected, labor-related operating ratios further reflect the increasing productivity of packinghouse labor.

Year	Production workers as % of total	Value added per employee	Payrolls as % of value added	Value added per man/hr.of prod. workers
1954	76%	$ 6,333	68%	$ 3.93
1958	75	8,702	61	5.66
1963	76	10,551	60	6.60
1967	77	12,949	57	8.05

Source: U.S. Department of Commerce - Census of Manufactures.

As shown by these data production workers as a percent of total employment has risen -- from 76 percent in 1954 to 77 percent in 1967, value added per employee has doubled -- from $6,333 in 1954 to $12,949 in 1967, payrolls as a percent of value added have decreased -- from 68 percent in 1954 to 57 percent in 1967, and value added per man hour of production worker has increased from $3.93 to $8.05 over the 1954-1967 period.

A further indication of the increasing productivity of labor in the meat packing industry is shown by the fact that expenditures for wages and salaries, as a percentage of the total meat sales dollar, decreased from 13.1 percent in 1960 to 9.6 percent in 1971.

Table I-8 shows the distribution of employment by number of employees per plant for 1958, 1963 and 1967. Over the 1958-1967 period a shift in employment patterns developed with the very small (under 20 employees) and the very large (over 1000 employees) plants losing both in terms of absolute numbers and percentage of total employment and with medium-sized plants increasing in importance. The greatest relative (6.3) percent) and absolute (2800 employees) gain was made by plants employing between 100 and 499 employees. The greatest loss (4.7 percent, 4700 employees) was in the 1000-2499 employees plant size. However, going back to 1954, a pronounced shift of employment out of the largest size plant is seen. In 1954, plants with over 2500 employees accounted for 59,700 employees, or 27.1 percent of the total. In 1967, this group of plants employed only 26,100 employees or 15.3 percent of the total, a decrease of over 50 percent in number of employees 1954 to 1967.

In the meat packing industry, a high proportion of the plants (65 percent in 1967) employ fewer than 20 employees and account for only 4.5 percent of total industry employment. At the other end of the scale, 8 large plants (0.3 percent by number) employed 15.3 percent of the industry total in 1967.

Wages, Labor Organization and Skill Levels

Wages in the meat packing industry are relatively high, averaging 17 percent above the average for all manufacturing industries. In terms of total payrolls, average annual wages in 1967 ranged from about $5,300 in small plants to over $8,000 in large plants. The distribution of wages in 1967 was as follows:

No. employees per plant	Average annual wage
1-4	$5,353
5-9	5,500
10-19	5,366
20-49	6,060
50-99	6,450
100-249	6,971
250-499	7,537
500-999	7,701
1,000-2,499	8,044
2,500+	8,321

Source: U.S. Department of Commerce, Census of Manufacturers.

Table I-8. Employment in the meat packing industry, employees per plant, by size group, 1958, 1963, 1967[1/]

Number of employees	Meat Packing 1967 No. plants	%	Em-ployees (000)	%	1963 No. Plants	%	Em-ployees (000)	%	1958 No. plants	%	Em-ployees (000)	%
Less than 20	1,742	64.6	7.6	4.5	2,016	67.4	9.9	5.5	1,824	65.1	10.0	5.0
20-99	641	23.8	28.6	16.8	677	22.6	29.2	16.1	668	23.8	29.0	14.4
100-499	253	9.4	54.3	31.9	232	7.8	49.8	27.5	231	8.2	51.5	25.6
500-999	30	1.1	22.1	13.0	34	1.1	24.7	13.6	38	1.4	26.1	13.0
1,000-2,499	23	0.8	31.7	18.5	24	0.8	36.5	20.1	30	1.1	46.5	23.2
2,500 or more	8	0.3	26.1	15.3	9	0.3	31.1	17.2	10	0.4	37.7	18.8
Total	2,697	100.0	170.5	100.0	2,992	100.0	180.9	100.0	801	100.0	200.8	100.0

1/ Source: U.S. Department of Commerce, Census of Manufacture 1967, 1963, 1958.

A 40-hour week is typical for most meat packing plants, with time and a half being paid for work beyond an eight-hour day or a 40-hour week. Wage differentials are also generally paid to employees working on late shifts. In addition, labor contracts generally have provisions for a minimum work week, with pay for 36 hours guaranteed whether worked or not.

Plants with collective bargaining agreements covering a majority of production workers, employ over 80 percent of the workers in the meat packing industry. Union membership is somewhat higher in the plants of multi-plant companies than the single-plant firms. The Amalgamated Meat Cutters and Butchers Workmen of North America, the United Packinghouse, Food and Allied Workers and the National Brotherhood of Packinghouse and Dairy Workers are the major unions in the industry.

There is a variety of skill levels required of workers in the industry. Although many of the operations formerly done by hand have been semi-mechanized, there are still many processes which demand a high degree of manual dexterity and skill. Skinning, cutting, trimming, boning, carcass breaking and similar operations require skilled workers to achieve efficient operation and to produce a quality product.

II. FINANCIAL PROFILE OF THE MEAT INDUSTRY

Earnings

Both the meat packing industry and the meat processing industry are characterized by high dollar volumes of sales and low earnings per dollar of sales.

Based on an analysis of 40 major industry groups by the First National City Bank of New York, in 1972 the meat packing industry ranked 40th in return on sales and 39th in return on net worth.

The American Meat Institute collects and analyzes, on an annual basis, certain financial information concerning the meat industry. Ratios of earnings to sales, earnings to total assets and earnings to net worth are calculated for national packers, regional packers, sectional packers and local packers. Table II-1 shows these earnings ratios for the meat packing industry, 1959-1971.

Earnings-to-sales - Over the 13 years, 1959 through 1971, meat packers earned approximately one percent returns on sales, the return in 1972 being 0.8 percent. There was a small variation in earnings between different sizes of packers, smaller packers (local and sectional) averaging slightly higher earnings on sales than the large regional and national packers (Table II-1). Returns were generally low during the early 1960's, but 1971 was one of the most profitable years on record. The favorable 1971 earnings were related to record volumes of meat processed and a slight decline in costs of raw materials relative to prices of finished products.

Earnings-to-total-assets - Rates of return on total assets over the 1959-1971 period averaged 5.23 percent (Table II-1). Returns to assets of national packers (3.96 percent) were substantially lower than returns of regional (5.58 percent), sectional (6.37 percent) and local (5.24 percent) packers. Again, 1971 was one of the most profitable years on record, earnings-to-total-assets averaging 7.59 percent.

Earnings-to-net-worth - The ratio of earnings-to-net-worth for the meat and packing industry averaged 8.53 percent over the 1959-1971 period (Table II-1 and Figure II-1). Again, earnings of large, national packers were lower than other groups. Earnings in 1971 were among the highest on record, averaging 13.52 percent, but dropped substantially in 1972.

Table II-1. Earnings ratios for meat packing companies, 1959-1971 1/

Year	Earnings to sales				Earnings to total assets				Earnings to net worth			
	National Packers	Regional Packers	Sectional Packers	Local Packers	National Packers	Regional Packers	Sectional Packers	Local Packers	National Packers	Regional Packers	Sectional Packers	Local Packers
	%	%	%	%	%	%	%	%	%	%	%	%
1971	1.57	1.06	1.93	1.70	6.26	7.15	9.21	7.75	11.53	13.47	15.87	13.23
1970	1.19	.75	1.23	1.16	5.25	4.83	6.37	6.20	10.42	9.46	10.88	10.45
1969	.92	.77	1.05	.78	4.10	5.41	5.26	3.85	8.19	10.76	8.75	6.30
1968	.96	.82	1.16	.61	4.25	5.49	6.73	2.93	8.32	9.50	9.96	5.01
1967	1.02	.98	1.25	1.26	4.27	6.59	6.76	6.08	8.22	11.18	10.70	9.23
1966	.59	.63	.92	1.21	2.70	4.38	5.28	6.02	5.07	7.87	8.54	9.14
1965	.65	.85	1.36	.56	2.84	5.44	7.59	2.64	4.69	8.71	10.61	4.22
1964	1.09	1.19	1.32	1.17	4.85	7.38	7.31	5.63	8.22	11.61	10.95	8.40
1963	.70	.88	1.13	1.18	3.18	5.31	6.11	5.61	5.34	7.87	8.89	7.88
1962	.65	.85	1.04	.93	3.01	5.18	6.03	4.51	5.05	7.87	8.93	5.74
1961	.56	.61	.75	1.13	2.59	3.67	4.24	6.26	4.37	5.32	6.21	8.18
1960	.78	.81	.86	.93	3.61	4.89	5.14	4.71	5.92	7.08	7.43	6.65
1959	.95	1.11	1.11	1.14	4.59	6.84	6.80	5.96	7.64	9.63	9.61	8.46
Average	.90	.87	1.16	1.06	3.96	5.58	6.37	5.24	7.15	9.26	9.79	7.91

1/ Source: "Financial Facts About the Meat Packing Industry," American Meat Institute, annual issues, 1961-1971.

2/ Earnings after tax.

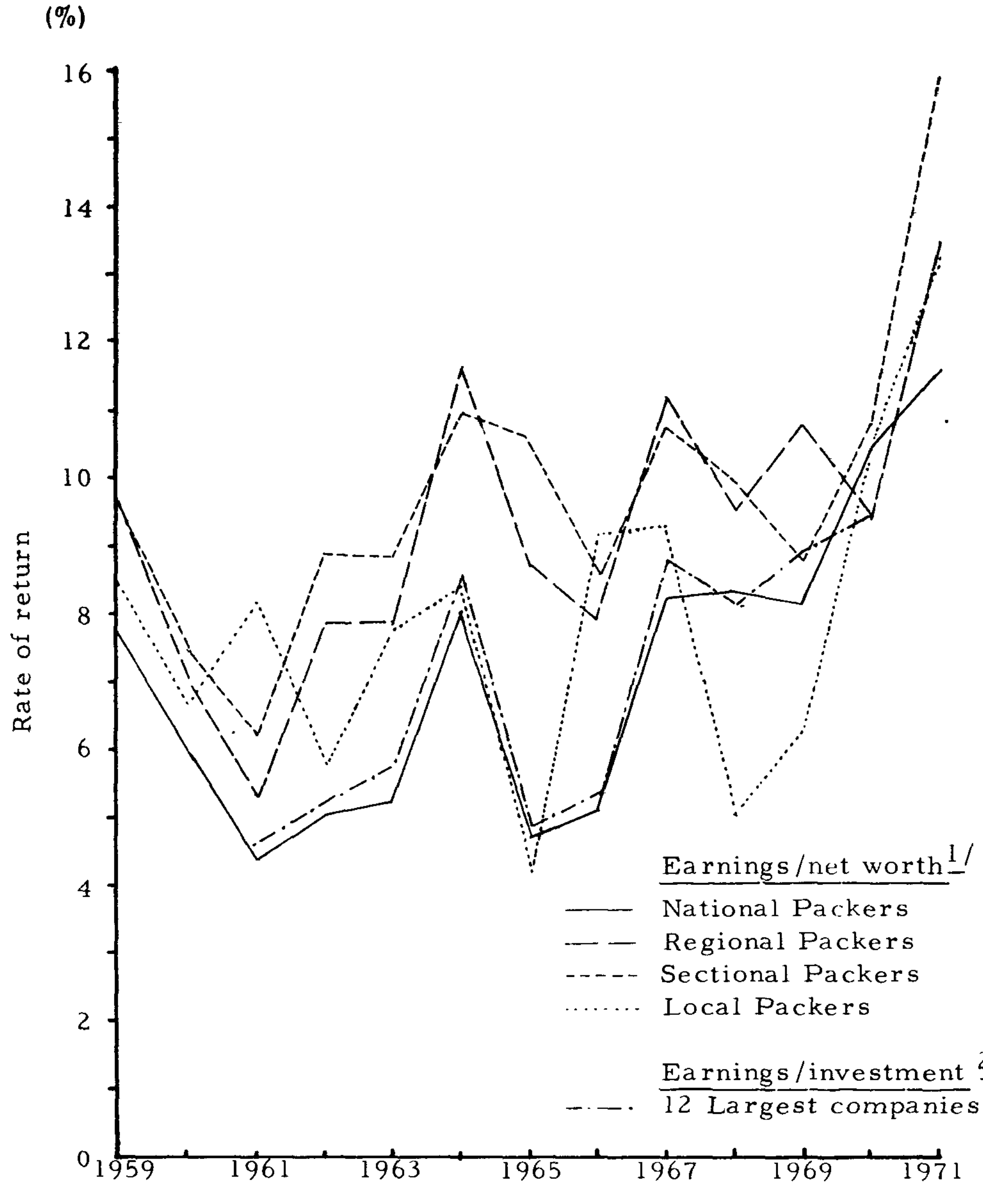


Figure II-1. Rates of return on net worth[1/] and on stockholders' investment[2/], meat packers, 1959-1971.

1/ Source: "Financial Facts about the Meat Packing Industry", American Meat Institute.

2/ Source: "Report of the Federal Trade Commission on Rates of Return in Selected Manufacturing Industries, 1961-1970", Federal Trade Commission.

Earnings - Major Meat Packing Firms

The Federal Trade Commission publishes information on rates of return on stockholders' investment for the 12 leading firms in 35 selected industries, including the meat industry. 1/ These data are as follows:

Table II-2. Rates of return on stockholders' investment (after taxes) for major firms in the meat products industry 1/

Year	Companies ranked 1-4 (%)	Companies ranked 5-8 (%)	Companies ranked 9-12 (%)	Total 12 companies (%)
1961	5.0	4.5	0.1	4.6
1962	5.6	4.2	3.6	5.2
1963	5.8	4.6	7.4	5.7
1964	8.2	10.1	7.4	8.5
1965	5.5	4.0	-1.5	4.8
1966	6.3	5.5	-9.2	5.3
1967	8.0	15.6	7.0	8.8
1968	7.3	14.5	8.8	8.1
1969	8.3	13.4	6.1	8.9
1970	9.3	9.9	9.7	9.4

1/ Report of the Federal Trade Commission on Rates of Return in Selected Manufacturing Industries, 1961-1970, Federal Trade Commission.

Table II-3. Distribution of total sales dollar, expenses and earnings in the meat packing industry, 1959-1971 1/

	Year												
	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960	1959
Total sales	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cost of livestock and other raw materials	75.5	77.0	76.8	76.1	75.8	77.7	75.0	72.9	73.7	74.1	73.7	72.7	73.5
Gross margin	24.5	23.0	23.2	23.9	24.2	22.3	25.0	27.1	26.3	25.9	26.3	27.3	26.5
Operating expenses													
Wages and salaries 2/	9.6	9.5	9.7	10.0	10.0	9.6	10.9	11.7	11.5	11.5	12.7	13.1	12.6
Employee benefits	2.0	1.9	1.9	1.9	1.8	1.8	1.8	1.9	2.0	1.9	1.1	1.1	.9
Interest	.3	.4	.3	.3	.3	.2	.2	.2	.2	.2	.2	.2	.2
Depreciation	.8	.7	.7	.8	.8	.7	.8	.8	.8	.8	.8	.8	.8
Rents 3/	.3	.3	.3	.3	.3	.3	.4	.4	.3	.2			
Taxes 4/	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
Supplies and containers	3.3	3.2	3.3	3.3	3.4	3.1	3.5	3.8	3.8	3.7	3.9	4.0	3.9
All other expenses	5.2	4.8	5.0	5.3	5.6	5.1	5.7	6.0	5.9	5.8	6.1	6.2	5.8
Total operating expenses	21.8	21.1	21.5	22.2	22.5	21.1	23.6	25.1	24.8	24.4	25.1	25.7	24.5
Earnings before taxes	2.7	1.9	1.7	1.7	1.7	1.2	1.4	2.0	1.5	1.5	1.2	1.6	2.0
Income taxes	1.2	.9	.8	.8	.7	.5	.6	.9	.7	.7	.6	.8	1.0
Net earnings	1.5	1.0	.9	.9	1.0	.7	.8	1.1	.8	.8	.6	.8	1.0

1/ Source: "Financial Facts About the Meat Packing Industry," American Meat Institute, annual issues.

2/ Vacation, holidays and sick leave not reported separately until 1962 and was included in wages and salaries in previous years.

3/ Rents not reported separately until 1962 and were included in all other expenses in previous years.

4/ Other than social security and income taxes

Federal Trade Commission reports on returns on stockholders investment for the 12 largest companies in the meat packing industry show some interesting relationships:

1. The 4 largest firms were less profitable on the average (6.9%) than were the 5th through the 8th largest (8.6%), but were more profitable than the 9th - 12th largest firms (3.9%).

2. Although the four largest firms were only average in profitability, profit levels were more stable than for the other 8 leading firms.

3. During the period 1967-1970, the middle group of firms averaged 13.4 percent return compared to 8.2 percent for the first four firms and 7.9 percent for the 9th through 12th largest firms.

Distribution of Total Sales Dollar

Distribution of the total sales dollar, in terms of expenses and earnings for the meat packing industry, is shown in Table II-3.

A characteristic of the meat packing industry is that the cost of raw materials constitutes a high percentage of total costs (75 percent).

Wages and salaries constitute about half of all other operating expenses. Over the period since 1959 automation and improved product handling methods have enabled the meat packing industry to reduce the labor input from an amount of 13 percent of the sales dollar to 9.5 percent. However, relative increases in the cost of livestock and other raw materials have offset labor savings.

Annual Cash Flow

Annual cash flow, as used in this report, is the sum of earnings after tax plus depreciation allowances. Total industry estimates of these statistics have been calculated by the American Meat Institute since 1947. These data are shown in Table II-4.

Table II-4. Annual cash flows, meat packing industry, 1947-1971, millions $[1]

Year	Earnings after tax	Depreci-ation	Cash flow	Year	Earnings after tax	Depreci-ation	Cash flow
1971	$330	$176	506	1959	$136	$100	$236
1970	227	165	392	1958	77	90	167
1969	187	153	340	1957	79	83	162
1968	165	143	308	1956	113	78	191
1967	178	136	314	1955	105	75	180
1966	117	128	245	1954	48	65	113
1965	126	124	250	1953	86	61	147
1964	165	112	277	1952	52	60	112
1963	117	115	232	1951	84	60	144
1962	112	108	220	1950	89	52	141
1961	84	109	193	1949	61	48	109
1960	110	102	212	1948	96	42	138
				1947	152	32	184

1/ Source: American Meat Institute, "Financial Facts about the Meat Packing Industry."

Evaluation of the cash flows shown in Table II-4 indicates a steadily increasing cash flow trend in the industry from $193 million in 1961 to $506 million in 1971. Depreciation has increased steadily, from $32 million in 1947 to $176 in 1971, an indication of the increasing capital investment in the industry. Depreciation, as a percent of total sales, increased from 0.4 percent in 1947 and 1948 to the range of 0.7 to 0.8 percent in recent years. Earnings on sales after tax have been more variable, ranging from a low of $48 million (0.4 percent) in 1954 to a high of $330 million (1.5 percent) in 1971.

C. sh Flows and Internal Rates of Return - Representative Plants

In order to provide a base from which to measure the impact of water pollution controls on the meat industry, it was necessary to establish "representative" plants and to synthesize investments, operating costs, working capital requirements, revenues and cash flows for these plants. Given these data, fully discounted internal rates of return were calculated for each type of plant with varying assumptions as to size and investment cost basis. All plants were assumed to operate at 85 percent of capacity on a single shift, 5-day week.

Types of Plants

Models were developed for two basic types of plants:

1. Meat packinghouses - kill and process both cattle and hogs.

2. Specialized slaughter plants - kill and sell carcasses and raw by-products only - do no processing.

    a. Cattle slaughter plants
    b. Hog Slaughter plants
    c. Cattle/hog combined slaughterplants.

Sizes of Plants

For each type of plant, three sizes were specified: large, medium and small, as follows:

Meat packinghouses

Large - kill 280 million pounds liveweight annually, equivalent to 144 head of cattle and 625 head of hogs per hour and process 50 million pounds of product annually.

Medium - kill 140 million pounds liveweight annually, equivalent to 72 head of cattle and 312 head of hogs per hour and process 25 million pounds of product annually.

Small - kill 23 million pounds of liveweight annually, equivalent to 6 head of cattle and 52 head of hogs per hour and process 5 million pounds of product annually.

Specialized slaughter plants

Large - kill 280 million pounds liveweight annually.

Cattle slaughter plants - equivalent to 144 head of cattle per hour.

Combined cattle/hog slaughter plants - equivalent to 72 head of cattle and 312 head of hogs per hour.

Medium - kill 140 million pounds liveweight annually.

Cattle slaughter plants - equivalent to 72 head of cattle per hour.

Combined cattle/hog slaughter plants - equivalent to 36 head of cattle and 156 head of hogs.

Small - kill 23 million pounds liveweight annually.

Cattle slaughter plants - equivalent to 12 head of cattle per hour.

Combined cattle/hog slaughter plants - equivalent to 6 head of cattle per hour and 26 head of hogs per hour.

Investment Assumptions

Cash flows and rates of return were run on the basis of two different investment assumptions for each plant.

1. Full replacement cost - equivalent to 100% of the cost of land, buildings and equipment for a new plant.

2. 10 percent of replacement cost plus original value of land - equivalent to the salvage value of a plant where the site has an appreciable value for other uses.

Utilization

For the purposes of this analysis all plants were assumed to operate at 85 percent of capacity as an average for the industry. It is recognized that a new, well-located slaughter or meat packing plant may operate at 100 percent of capacity, or even above 100 percent through double shift operation, but 85 percent was judged to be a reasonable performance rate.

Description of Model Plants and Products Handled

Beef Slaughter Plants

The prototype beef slaughter plants of all three sizes are kill and chill only. The entire output is shipped as sides of carcass beef. The analysis is based on 1,040-pound U. S. choice slaughter steers. The delivered purchase cost of $319.70 per head is based on the 1968-72 average price of $30.74 cwt. for the seven Midwest markets.

The average chilled dressing percentage is taken at 61.06 percent, making a 635-pound carcass weight. Average carcass sales revenue is $333.39 per head, based on the 1968-72 average price of $48.80 cwt. at the Midwest, Iowa and Missouri River markets. By-product value is taken at $23.51 per head, based on 1968-72 average prices. The total base slaughter margin is $13.69 per head.

The small plant is assumed to have slight locational advantages with respect to both livestock supplies and product markets. Livestock costs are taken at one percent less than the base cost, and product prices are taken at one percent more than the base sales price.

Beef/Pork Slaughter Plants

The dual-species slaughter plants are kill and chill only. The small plant operates with one crew, slaughtering one species for half the shift and then switching to the other species. The two larger plants operate with separate and concurrent crews for the two species.

The livestock weights and costs, the yields and the product values are the same as those for the specialized slaughter plants. Locational advantage for the small plant is assumed to be two percent on raw material costs and two percent on product prices. A locational advantage of one percent on raw material costs is assumed for the medium-sized plant.

Meat Packinghouses

The prototype plants for slaughtering both species plus processing represent combinations of beef-pork slaughter plants plus processing. The sales product mix is the same as that shown in Table II-5 plus fresh beef and pork carcasses.

The revenue for these plants is calculated as Total Sales for Beef-Pork Slaughter Plant + Total Sales for the Processed Products - Cost of Raw Materials for processing.

Plant Categories

Slaughterhouses and packinghouses were further categorized based on the degree to which by-products are processed, as follows:

Simple Slaughterhouse--is defined as a slaughterhouse that does a very limited amount of processing of by-products (i.e., secondary processing). Usually, no more than two secondary processes, such as rendering, paunch and viscera handling, blood processing, or hide or hair processing are carried out.

Complex Slaughterhouse--is defined as a slaughterhouse that does extensive processing of by-products (i.e., secondary processing). It usually carries out at least three of the secondary processes listed above.

Low-Processing Packinghouse--is defined as a packinghouse that normally processes less than the total animals killed at the site, but may process up to the total killed.

High-Processing Packinghouse--is defined as a packinghouse that processes both the total kill at the site and additional carcasses from outside sources.

By-Product Operations--Assumptions

By-product assumptions for the sizes and types of plants analyzed, were as follows:

1. Simple Slaughterer

   a. Small--no by-product processing, sells all of fat and hides
   b. Medium--render - inedible, dry process
      dry salt hides
   c. Large--no large plants in this category.

2. Complex Slaughterer

   a. Small--no small plants in this category
   b. Medium--edible rendering - dry process
      inedible rendering - dry process
      dry salt hides
   c. Large--edible rendering - dry process
      inedible rendering - dry process
      dry salt hides
      processes blood meal.

3. Low-process Packinghouse

   a. Small--edible rendering, dry process
   b. Medium--edible rendering, dry process
      inedible rendering, dry process
      dry salt hides
   c. Large--edible rendering, dry process
      inedible rendering, dry process
      dry salt hides
      processes blood meal.

4. High-process Packinghouse

   By-product processing - for all sizes - same as low-process packinghouse.

   High-process packinghouse limited to firms primarily engaged in pork processing.

Table II-5 Product mix and margins for processing plants

Product	Volume (percent)	Yield (percent)	Sales Price ($/cwt)	Cost Price ($/cwt)	Gross Margin/ cwt/sales ($/cwt)
Regular hams	8.278	108.91[a]	47.63	43.54	7.65
Boneless hams	9.817	89.85[b]	70.00	52.76	17.24
Other smoked products	2.695	108.91[a]	36.33	29.00	9.70
Fresh sausage	7.700	103.09[c]	40.96	22.94[e]	18.71
Bacon	17.710	108.91[a]	59.75	37.54[f]	25.28
Franks	15.400	120.05[d]	53.37	31.38	27.23
Bologna	9.620	120.05[d]	39.64	27.36	16.85
Lunch loaf	5.780	120.05[d]	50.52	25.51	29.27
Canned & misc.	23.000	108.91[a]	47.63	43.54	7.65
	100.000				

a/ 1/1.009 x .91

b/ .825/1.009 x .91

c/ 1/.97

d/ 1/.833

e/ Lean trim containing a maximum of 50% fat.

f/ Bacon cost price is skinless basis calculated as 105% of the skin on price for seedlings green bellies.

Annual Throughput

The annual throughput used as basis for the revenue, cost and gross profit calculations for the prototype slaughter plants is shown in Table II-5. Three output levels are shown (1) full capacity operation, (2) 85 percent of capacity and 70 percent of capacity. All capacity figures are based on one shift operations, assuming 7.5 hours of productive slaughter time per day. The small beef-pork slaughter plant operates with one killing crew for both species, operating each line for four hours. Annual throughput is based on 250 operating days per year.

Annual throughput for the meat packing plant is based on the following, at 85 percent capacity:

	No. Head	Million Pounds
Large Plant		
Cattle slaughtered	114,750	119.3
Hogs slaughtered	498,047	117.0
Processed meats	-	42.5
Medium Plant		
Cattle slaughtered	57,375	59.7
Hogs slaughtered	248,625	58.4
Processed meats	-	21.2
Small Plant		
Cattle slaughtered	9,562	9.9
Hogs slaughtered	41,438	9.7
Processed meats	-	4.2

Annual Profits

Pre-tax income, return on average invested capital before and after taxes and after tax return on sales, for the types and sizes of slaughter and meat packing plants analyzed, are shown in Table II-6.

Pre-tax income was derived as follows:

Gross sales
- Raw materials cost (livestock or meat materials)
= Gross margin
- Direct and indirect operating expenses
= Cash earnings
- Depreciation and interest
= Pre-tax income

Table II-5 . Annual throughput conditions for model slaughter plants

Plant Size	Capacity (hd/hr)	Annual Kill Volume[a] Full Capacity No. Head	mil. lbs.	85% Capacity No. Head	mil. lbs.	70% Capacity No. Head	mil. lbs.
				Beef Plants			
Small	12	22,500	23.4	19,125	19.8	15,750	16.3
Medium	72	135,000	140.4	114,750	119.3	94,500	98.3
Large	144	270,000	280.8	229,500	238.6	189,000	196.5
				Hog Plants			
Small	52	97,500	22.9	82,875	19.4	68,250	16.0
Medium	312	585,000	137.4	497,250	116.8	409,500	96.2
Large	625	1,171,875	275.3	996,094	234.0	820,312	192.7
				Combined Beef and Hog Plants			
Small							
Beef	6[b]	11,250	11.7	9,562	9.9	7,875	8.2
Hogs	26[b]	48,750	11.5	41,438	9.7	34,125	8.0
Total			23.2		19.6		16.2
Medium							
Beef	36	67,500	70.2	57,375	59.7	47,250	49.1
Hogs	156	292,500	68.7	248,625	58.4	204,750	48.1
Total			138.9		118.1		97.2
Large							
Beef	72	135,000	140.4	114,750	119.3	94,500	98.3
Hogs	312	585,938	137.7	498,047	117.0	410.157	96.4
Total			278.1		236.3		194.7

a/ Throughput calculated on the basis of 7.5 hours of productive operation per day.

b/ These capacities each operated for four hours per day, using the same killing crew.

Table II-6. Pre-tax net income and rate of return on average invested capital and after tax return on sales for meat packing plants

Type and Size of Plan	Pre-tax Income ($000)	Pre-tax ROI* (%)	After tax ROI* (%)	After tax return on sales (%)
Simple Beef Slaughter				
Small	35	8.0	4.1	0.28
Medium	315	14.0	7.3	0.43
Complex Beef Slaughter				
Medium	322	14.1	7.3	0.44
Large	651	15.9	8.3	0.45
Simple Combined Slaughter				
Small	59	12.0	6.3	0.56
Medium	322	14.4	7.5	0.52
Complex Combined Slaughter				
Medium	330	14.5	7.5	0.52
Large	720	18.2	9.5	0.57
Meat Packing House				
Small	125	10.9	5.7	0.80
Medium	846	16.5	8.6	0.94
Large	1,998	21.7	11.3	1.11

* Average return on fixed investment calculated by financial statement method.

These data were developed from a combination of published and unpublished sources and were checked against available information on industry financial ratios and other measures of industry financial performance, to insure their credibility.

Average invested capital was calculated as follows:

  Average fixed assets (1/2 of replacement cost)
\+ Total working capital
\- Current liabilities
= Average invested capital

Average fixed assets were estimated from previously published research (updated and adjusted for plant size and type), engineering estimates of plant and equipment and industry information on new plant costs. These estimates, developed in the earlier EPA study by DPRA, were checked with meat plant architects and other knowledgable individuals.

Working capital, for slaughter operations, was calculated from the formula WC = (2/52 · Raw Product Cost) + (1/12 · Annual Operating Expense). Working capital for processing operations was derived WC = (3/52 · Raw Product Cost) + (1/12 · Annual Operating Expense).

Current liabilities were estimated from industry performance ratios as reported by the American Meat Industry and the Almanac of Business and Industrial Financial Ratios--1973, Prentice-Hall, Inc. which develops its ratios from IRS data.

After-tax return on sales is also reported since this is the measure of returns commonly quoted by the meat packing industry.

Pre-tax returns on average invested capital varied directly with size of plant (Table II-6). For slaughter only plants (kill and chill-carcass sales), hog slaughter plants were more profitable than beef slaughter plants and the combined slaughter plant showed returns midway between those of the specialized plants. The addition of processing operations in the meat packing plants increased returns substantially above the combined slaughter only plant. Although pre-tax returns on average invested capital appear high, comparison of these calculated returns with reports from industry and IRS data indicate that they are within industry performance ranges.

Annual Cash Flow

Aggregate cash flow estimates for the meat packing industry, developed from American Meat Institute estimates, are shown in Table II-4, page II-7. As indicated, industry cash flows have increased steadily from 1961 to 1971.

Estimated annual cash flows for the types and sizes of plants analyzed in this study are shown in Table II-7. Cash flow, as calculated, is the sum of after-tax income plus depreciation.

There was little difference in cash flows generated between equivalent sizes of slaughter only plants. However, the addition of cutting and processing operations resulted in cash flows for the meat packing plants which were double to triple those of the simple slaughter plants. Much the same situation existed when cash flow was measured as a percentage of average fixed investment. Although the medium and large packinghouses showed ratios substantially above those of slaughter plants, the small packinghouse had a cash flow/fixed investment ratio approximately equivalent to that of the slaughter-only plants.

Market Value of Assets

The market or salvage value of meat plants will vary widely from plant to plant, depending on the age of the plant and its equipment, the condition of the plant and equipment and its location.

In common with most food processing plants, meat packing plants undergo periodic renovation, continuous repair and maintenance and equipment items are replaced as they wear out or become obsolete. In recent years, more stringent enforcement inspection (FDA) requirements and concurrent stiffening of state inspection has forced many plants to either undergo extensive remodeling or to close. This is seen in the fact that from 1971 to 1973 the number of slaughter plants dropped from 6,400 to 5,991 but the number of Federally-inspected plants rose from 766 to 1,364. As a result of these requirements, existing plants are in a better condition and are better equipped than was true in past years.

Estimated replacement (new plant and equipment) value and working capital requirements for meat packing plants are shown in Table II-8. It is recognized that the market value and/or the salvage value of a meat packing will, in most instances, be substantially below its replacement value.

Table II-7. Estimated cash flow for meat packing plants.

	Annual Cash Flow ($000)	Cash Flow on Average Fixed Investment (%)
Simple Beef Slaughter		
Small	48	11.0
Medium	323	14.4
Complex Beef Slaughter		
Medium	331	14.5
Large	617	15.1
Simple Combined Slaughter		
Small	67	13.6
Medium	332	14.8
Complex Combined Slaughter		
Medium	342	15.0
Large	658	16.7
Meat Packing House		
Small	163	14.2
Medium	886	17.2
Large	1,826	19.9

Table II-8. Estimated replacement value and working capital requirements for meat packing plants

Type and size of plant	Replacement value of plant, equipment and site ($000)	Total working capital requirement ($000)	Current liabilities ($000)	Replacement value of total assets ($000)
Simple Beef Slaughter				
Small	586	262	117	731
Medium	2,812	1,517	675	3,654
Complex Combined Slaughter				
Medium	2,893	1,517	675	3,735
Large	4,842	3,004	1,337	6,509
Simple Combined Slaughter				
Small	728	233	104	857
Medium	3,002	1,333	593	3,742
Complex Combined Slaughter				
Medium	3,083	1,333	593	3,823
Large	4,995	2,617	1,165	6,447
Meat Packing House				
Small	1,797	453	202	2,048
Medium	7,610	2,403	1,069	8,944
Large	13,139	4,729	2,104	15,764

Old packing plants were often multi-level with product flow by gravity. Newer plants are generally essentially single-level plants with powered conveyor product movement. However, whether old or new, meat packing and slaughter plants are special-purpose facilities with the result that their market value (except possibly for refrigerated storage space) for purposes other than meat packing is normally low. In a few instances, modern plants which have been shut down by one firm have been sold to another, e.g. the sale of the new Armour plant at Emporia, Kansas to Iowa Beef Processors, but even in these situations, the market value of the plant is usually substantially below its replacement cost. In many instances, the salvage value of old, obsolete plants will be equal only to the site value. However, in some instances, e.g. in Chicago or Kansas City, old, obsolete plants built before 1900 were occupying land which had relatively high industrial site values.

Where plants are forced to close because they are presently unprofitable, or because they would become unprofitable if they were forced to assume the added investments and operating costs required for water pollution control, then the salvage value of the buildings would be essentially zero, the equipment might sell from 10 to 50 percent of its original cost and the value of the site could vary widely, depending on location.

In many instances, the value of a packinghouse, particularly where a small firm is involved, would be greater to its present owner than it would be to any potential buyer. In terms of "book value", the physical facilities and equipment may have been fully depreciated, or nearly so, but in terms of their "use value" to their present owners, these plants may represent assets of very tangible values--much greater than their market or their salvage value.

Since no data are available on actual salvage values for meat packing plants and since a "market" for plants which would be forced to close, because of added costs of water pollution control, would be virtually non-existent, the impact analysis will use arbitrary assumptions. All operating capital will be recovered intact, land will be valued at its original cost and buildings and equipment will be valued at 10 percent of their original value. The combined value of operating capital, land, buildings, and equipment will represent the salvage value to be used.

Cost Structure

Revenues and costs for large, medium and small slaughter plants and meat packinghouses as specified in this project are given in Tables II-9 through II-11.

Raw materials costs were developed on the basis of the number and cost of animals slaughtered and, in the case of the packinghouse, where processed meats are included, the volume and cost of raw meat products (trimmings, green pork bellies, skinned raw hams etc) was included.

The following physical relationships were used:

Cattle	- choice 1040 lb. steers 61.06 percent dressed yield 635 pound carcass weight
Hogs	- 235 lb. slaughter barrows and gilts 70.2 percent dressed yield, packer style 165 pound carcass weight
Processed Products	- product mix, costs and prices were as shown on page II-11 of this report.

Direct and indirect operating costs were developed on the basis of estimates from published studies, up-dated and adjusted to plant types and sizes indicated, and checked against performance data from industry sources. In the case of meat packing plants, direct and indirect costs were aggregated due to lack of data required for allocation between slaughter and processing operations.

Depreciation and interest for meat packing plants were based on indicated rates from industry sources and from the Almanac of Business and Industrial Financial Ratios which develops its data from IRS sources. For slaughter plants depreciation was estimated by straight-line depreciation on estimated replacement cost. Interest was calculated in relationship to reported industry practices.

Cost Relationships

Raw product costs - livestock and raw materials for meat processing, constitute the largest single cost item in the meat industry, accounting for over 90 percent of total costs in slaughter-only plants and 75 to 80

Table II-9. Estimated costs for beef slaughter plants

Item	Size of Plant							
	Complex Large		Complex Medium		Simple Medium		Simple Small	
	$000	(%)	$000	(%)	$000	(%)	$000	(%)
Sales	76,658	100.0	38,325	100.0	38,313	100.0	6,385	100.0
Raw materials cost	73,371	95.7	36,538	95.3	36,538	95.4	6,053	94.8
Direct operating cost	1,485	1.9	736	1.9	736	1.9	116	1.8
Indirect operating cost	698	0.9	456	1.2	456	1.2	121	1.9
Depreciation	278	0.4	164	0.4	159	0.4	30	0.5
Interest	175	0.2	109	0.3	109	0.3	30	0.5
Total before tax cost	76,007	99.2	38,003	99.1	37,998	99.2	6,350	99.5

Table II-10. Estimated costs for combined beef and hog plants

Item	Size of Plant							
	Complex Large		Complex Medium		Simple Medium		Simple Small	
	$000	(%)	$000	(%)	$000	(%)	$000	(%)
Sales	65,971	100.0	32,959	100.0	32,946	100.0	5,528	100.0
Raw materials cost	62,320	94.5	31,077	94.3	31,077	94.3	5,122	92.7
Direct operating cost	1,714	2.6	836	2.5	836	2.5	138	2.5
Indirect operating cost	745	1.1	425	1.3	425	1.3	136	2.5
Depreciation	284	0.4	170	0.5	165	0.5	36	0.7
Interest	188	0.3	121	0.4	121	0.4	37	0.7
Total before tax cost	65,251	98.9	32,629	99.0	32,624	99.0	5,469	98.9

Table II-11. Estimated costs for packing house plants.

Item	Size of Plant					
	Large		Medium		Small	
	$000	(%)	$000	(%)	$000	(%)
Sales	93,923	100.0	[illegible]	100.0	8,133	100.0
Raw materials cost	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	78.1
Direct operating cost / Indirect operating cost	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Depreciation	786	[illegible]	446	1.0	98	1.2
Interest	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total before tax cost	91,925	97.9	46,084	98.2	8,008	98.5

percent in meat packing plants. In general, raw product costs represent a slightly higher proportion of total costs in larger plants as administrative overhead and other fixed operating costs are spread over a larger volume of production. In meat packing plants, the cutting, breaking, boning, and processing operations all require additional amounts of labor and other materials such as containers, spices, and other non-meat ingredients and supplies associated with the manufacture of processed meat products.

Direct operating costs for slaughter plants include production labor and related employee benefits, utilities, miscellaneous supplies and materials and other variable cost items. Labor is by far the most important component of direct operating costs, accounting for over 70 percent of the total in beef slaughter plants and over 50 percent for hog slaughter plants. In general, labor accounted for a higher proportion of direct operating cost in larger plants then it did in smaller plants.

Indirect operating costs for slaughter plants include salaries of officers and other supervisory or administrative personnel and such other fixed costs as taxes, insurance, repairs, etc. Again, salaries and related fringe benefits represent the greatest part of indirect operating costs, accounting for 70 to 80 percent of indirect costs. Again, the percentage was higher for small plants than large plants.

Operating expenses for meat packing plants (both direct and indirect) accounted for approximately 18 percent of the total packer's sales dollar as follows:

	Percent of packer's sales dollar		
Operating cost item	Large Packer (%)	Medium Packer (%)	Small Packer (%)
Wages	8.0	8.5	9.0
Employee benefits	2.0	2.0	2.0
Officers' compensation	0.8	1.0	1.5
Repairs	0.8	0.8	0.8
Taxes	1.4	1.4	1.2
Advertising	1.5	1.0	0.5
Other expenses	3.5	3.5	3.5
Total	18.0	18.2	18.5

Depreciation and interest were treated as separate cost items and were based on reported industry rates.

Constraints on Financing Additional Capital Assets

Constraints on financing additional capital required for water pollution control facilities will vary greatly from firm-to-firm and from location-to-location. On the basis of the earlier study of the economic impact of water pollution controls on the meat industry,[1/] pollution control investments ranged from less than 10 percent of plant value for large plants to 20-30 percent for small plants.

In general, it is not anticipated that there will be any serious constraints in securing capital required for pollution control for large and medium size meat packing or slaughtering plants. However, in individual situations where plants are old and obsolete or unprofitable, and where local conditions may require substantial investments for internal pollution abatement systems or for participation in expanding capacity of sewer systems in small communities, meat industry management may hesitate to make the investments required -- even though capital may be available.

Capital availability may be a much more serious problem for small plants which continue to operate primarily because owners have depreciated out original investment costs, consider their investment in the plant as "sunk capital" and consider that the plant has a "utility value" if continued in operation which is greater than the "market value" or "salvage value" of the plant should they decide to cease operations. For such plants, the increased investment required for pollution control may be difficult to obtain and even if available may be unattractive to both the borrower and the lender. In these situations, the decision to attempt to obtain additional capital may be based on the desire of the owners to maintain the business for personal employment reasons rather than on the expectation of realizing a return on invested capital.

1/ Development Planning and Research Associates, Inc., "Initial Analysis of the Economic Impact of Water Pollution Control Costs Upon the Meat Industry," report to Environmental Protection Agency, November, 1972.

III. PRICE EFFECTS

Pricing Processes in the Meat Packing Industry

Price determination in the meat packing industry is primarily the result of the interaction of basic supply and demand conditions. In fact, the industry meets most of the criteria of competitive markets. On the supply side, meat packers are faced with large numbers of individual livestock producers, no one of whom is large enough to have an appreciable influence on supplies and who act independently, based on their personal opinions concerning present and future market conditions and anticipated prices. On the demand side, the meat packing industry sells to literally thousands of independent retail food outlets and supermarket chains. Although large food chains are an important factor in the retailing of meat and meat products, the food retailing industry is none-the-less competitive and the demand for meat is still primarily determined in the marketplace by the demands of millions of customers. The meat packing industry also meets one other major test of competition -- there are no artificial barriers to entry or exit in the industry. Although capital requirements are high, new firms do enter the industry, existing firms expand, contract or go out of existence and the organization, structure and ownership of the industry changes over time. Concentration in meat packing declined markedly following World War II, the percentage of total value of shipments accounted by the four largest firms dropping from 41 percent in 1947 to 26 percent in 1967.

The sharp increases in meat prices in recent months have become of increasing concern to consumers and have resulted in "meat boycotts" and other evidence of consumer resistance. (Figure III-1) Reflecting their disappointment, consumers have accused feeders, packers and meat retailers of forcing meat prices up when in fact a strong consumer demand has been a major factor in recent price increases.

Changes in retail meat prices result from the interaction of a series of economic factors rather than from arbitrary decisions by farmers, meat packers, wholesalers and retailers.

Underlying retail meat price increases has been a strong consumer demand. This has been a major factor in boosting meat prices in recent years. Based on 1967 = 100, the index of retail meat prices rose to 153 in March 1973. In spite of this substantial increase in prices, red

Table III-1. Retail price, beef, pork and lamb, U.S. average, 1972-73 [1/]

Year and month		Retail price, cents per pound		
		Beef choice grade	Pork retail cuts & sausage	Lamb choice grade
1972	January	111.5	76.3	113.4
	February	115.8	81.3	115.1
	March	115.8	79.4	115.2
	April	112.0	78.2	115.6
	May	111.4	79.4	115.2
	June	113.5	82.0	118.4
	July	117.3	85.6	120.6
	August	115.8	86.0	120.7
	September	112.9	86.6	120.1
	October	112.8	87.5	120.5
	November	112.3	87.2	121.4
	December	114.6	88.5	124.3
1973	January	122.3	94.1	125.6
	February	130.3	97.1	131.3
	March	135.3	103.0	133.5
	April			

1/ Source: Livestock and Meat Situation, ERS, USDA.

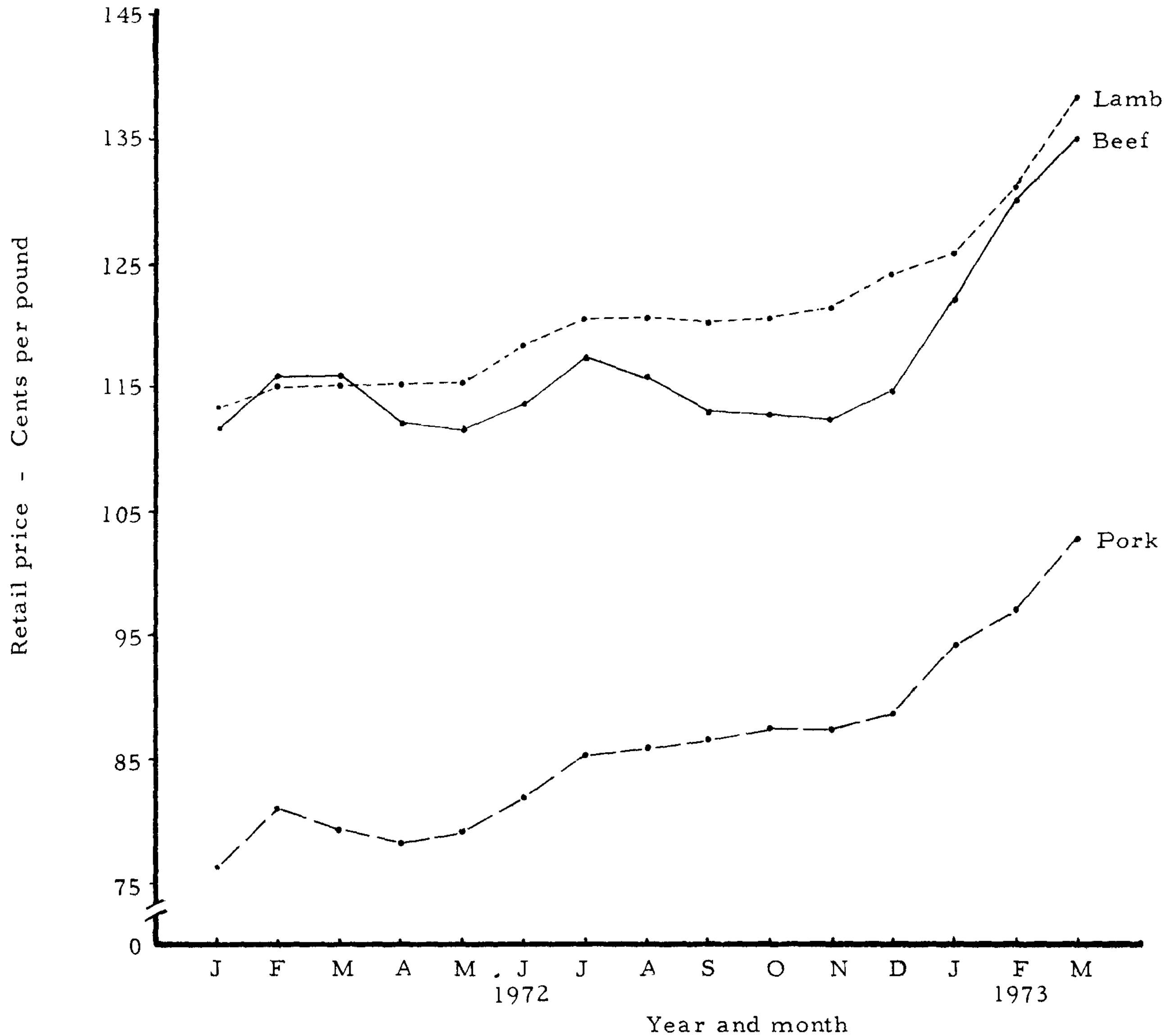


Figure III-1. Trend in retail meat prices for beef, pork and lamb, 1972-73.

meat consumption in 1973 is expected to remain near 190 pounds per capita, up 12 pounds from the 1967 consumption of 178 pounds. Although numerous factors contribute to rising meat demand, the existence of increasing demand with increasing prices has been primarily the result of steadily increasing per capita personal income. In numerous studies, it has been demonstrated that a rising demand for meat resulted from increases in per capita income. Increasing per capita consumption of meat, coupled with population growth have combined to keep pressure on meat supplies during recent years.

Price-making in the Market

Although in the long-run, the price of meat is established by the interaction of consumer demand and supplies of available slaughter livestock, daily price offers and quotations for wholesale meats made by packers are based on the current wholesale meat price, the value of by-products, cold storage holdings of meats and anticipated supplies and prices of slaughter livestock. Packers' offers for livestock are based on current wholesale meat and by-product prices, cold storage holdings of meats and anticipated prices of livestock.

This pricing process results in a relatively constant relationship between prices for live animals and wholesale meat prices (Figure III-2) Most of the variations which occur from time-to-time can be explained by current supply-demand conditions. Subject to lags built into the marketing system, there is a definite inverse relationship between supplies and prices of slaughter livestock (Figure III-3) which results in a corresponding relationship between livestock supplies and meat prices. The cyclic patterns evident in Figure III-3 are the result of characteristic cattle and hog production cycles. The cattle cycle extends approximately ten years from peak to peak, the hog cycle four years.

Demand and Supply Response to Price Changes

Increased costs, associated with the implementation of effluent control guidelines must be (1) absorbed by meat packers, (2) passed forward to consumers in the form of higher meat prices, or (3) passed backward to slaughter livestock producers in the form of lower prices for slaughter livestock, or a combination of (1), (2) and (3).

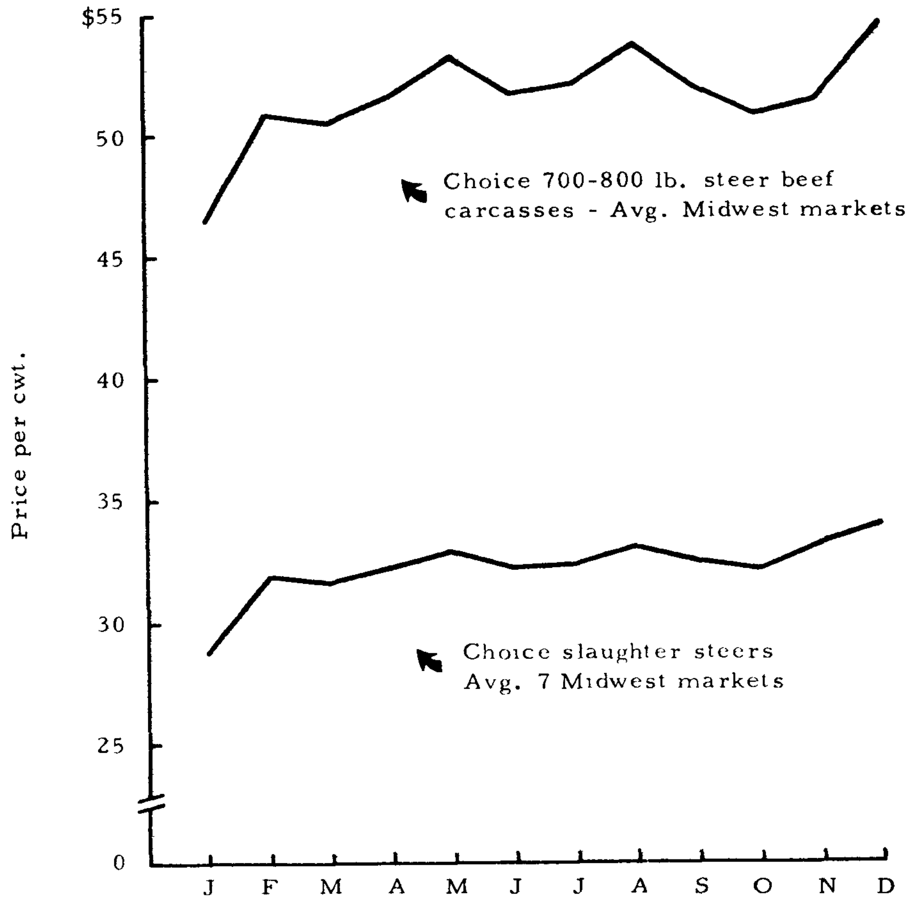
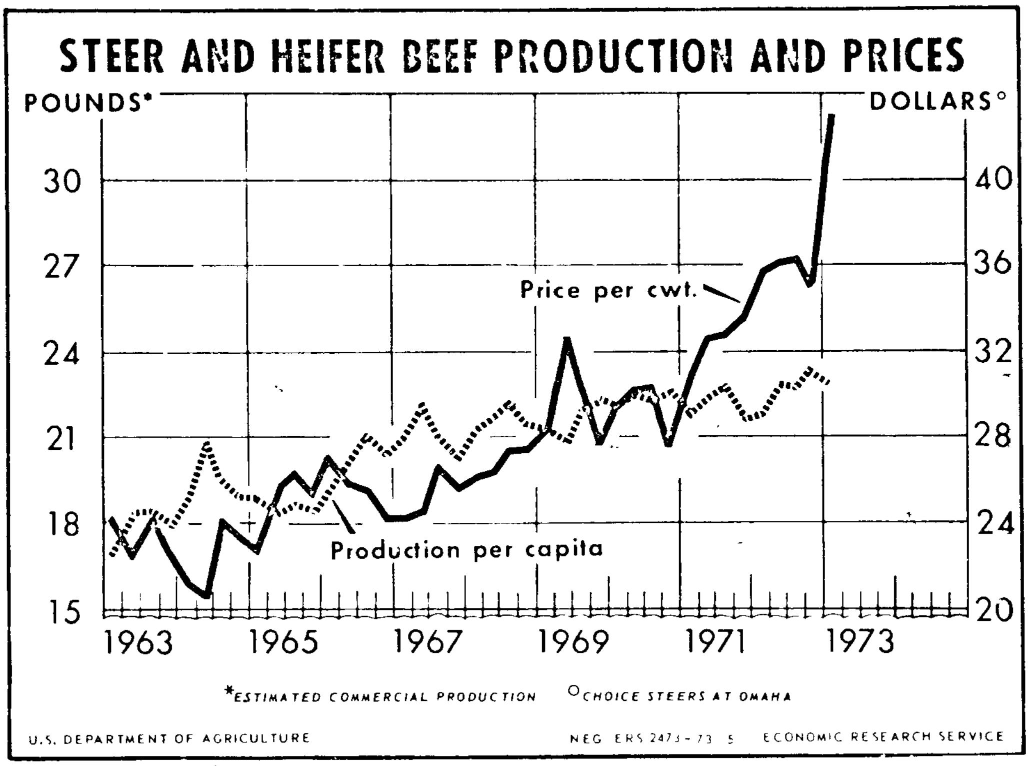


Figure III-2. Prices of choice steers and choice steer beef carcasses, Midwest markets, by months, 1971.



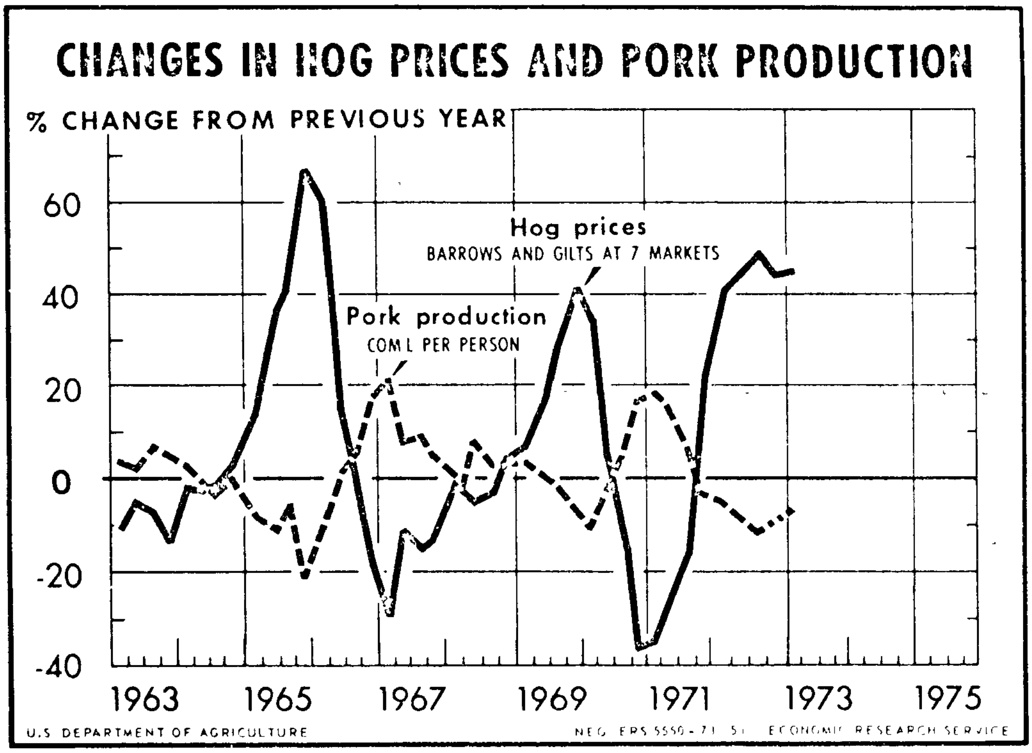


Figure III-3. Supply-price relationships, beef and pork production and prices.

Demand Factors - Consumers' responses to increased meat prices will be conditioned by price elasticity, which measures the proportionate change in quantity taken in response to a proportionate change in price. Two other relationships will also enter in: income elasticity, which measures the changes in demand related to changes in disposable income and cross-elasticity which measures the changes in demand associated with changes in price relationships between various types of meat (beef-pork, etc.) or between meat and other close substitutes (poultry, eggs, cheese, etc.).

Elasticity coefficients for meat products are shown in Table III-2 . In terms of price-elasticity, (Section A, Table III-2), beef and pork are relatively inelastic (coefficient less than one) in that changes in quantity taken are less than proportionate to changes in prices. However, the demand for lamb (coefficient -2.35) and veal (1.60) are relatively elastic.

Price-quantity relationships for meat products are further complicated by cross-elasticities (Section B). For example, the beef-pork coefficient indicates that a one percent increase in the price of pork would be associated by a 0.13 percent increase in the quantity of beef demanded -- indicating a relatively low substitution rate between pork and beef.

Income elasticites for most meat products in the United States are positive, but less than one (Section C, Table III-2). For example, the beef income elasticity coefficient shown indicates that a one percent rise in per capita income will be associated with a 0.47 percent increase in per capita consumption of beef. The income elasticity of demand for pork is lower than that for other meat products.

Supply Factors - The production responses for cattle and hogs to changes in slaughter livestock prices are more complex than was found in terms of demand responses to price changes. The key price factor affecting the volume of hog production is the hog-feed price ratio, not the hog price directly. Two price ratios influence cattle production response -- the cattle-feed price ratio and the feeder cattle-fed cattle price ratio. As

Table III-2. Elasticity coefficients for meat products[1/]

Elasticity measurement	Product	Coefficient
A. Price-elasticity	Beef	- .95
	Veal	-1.60
	Pork	- .75
	Lamb	-2.35
	Chicken	-1.16
	Fish	- .65
B. Cross-elasticity	Beef-veal	.38
	Beef-pork	.13
	Beef-lamb	.62
	Beef-chicken	.23
	Beef-fish	.02
	Pork-beef	.10
	Pork-veal	.19
	Pork-lamb	.41
	Pork-chicken	.16
	Pork-fish	.02
C. Income-elasticity	Beef	.47
	Veal	.58
	Pork	.32
	Lamb	.65
	Chicken	.37
	Fish	.42

1/ Source: Brandow, G. E., "Interrelations Among Demands for Farm Products and Implications for Control of Market Supply," Penn. Agr. Exp. Sta. Bull. 680.

would be expected, favorable price ratios induce increased production while deteriorating price ratios result in reduced production. However, the supply responses take time -- about two years for hogs and five years for fed cattle. Empirical research concerned with livestock price-supply response indicate supply elasticities of about 0.50 to 0.75 meaning that the adjustment in fed livestock supplies to a one percent change in price is about 0.50 to 0.75 percent in the same direction.

Likelihood of Price Changes

Potential price impacts of the imposition of stricter water pollution standards on the meat packing industry are higher retail prices, lower farm prices for livestock, lower profits for processors and lower meat production and consumption. The meat packing industry is already making low profits. Additional costs would tend to be passed on to the consumer. The relative amount to be passed on depends upon the extent to which lower-cost meat processing techniques develop allowing the efficient firms to offset this pollution abatement cost and forcing through market competition lower returns in the higher cost plants. With no dramatic change in meat packing techniques predicted, it is expected that packers will not absorb this added cost.

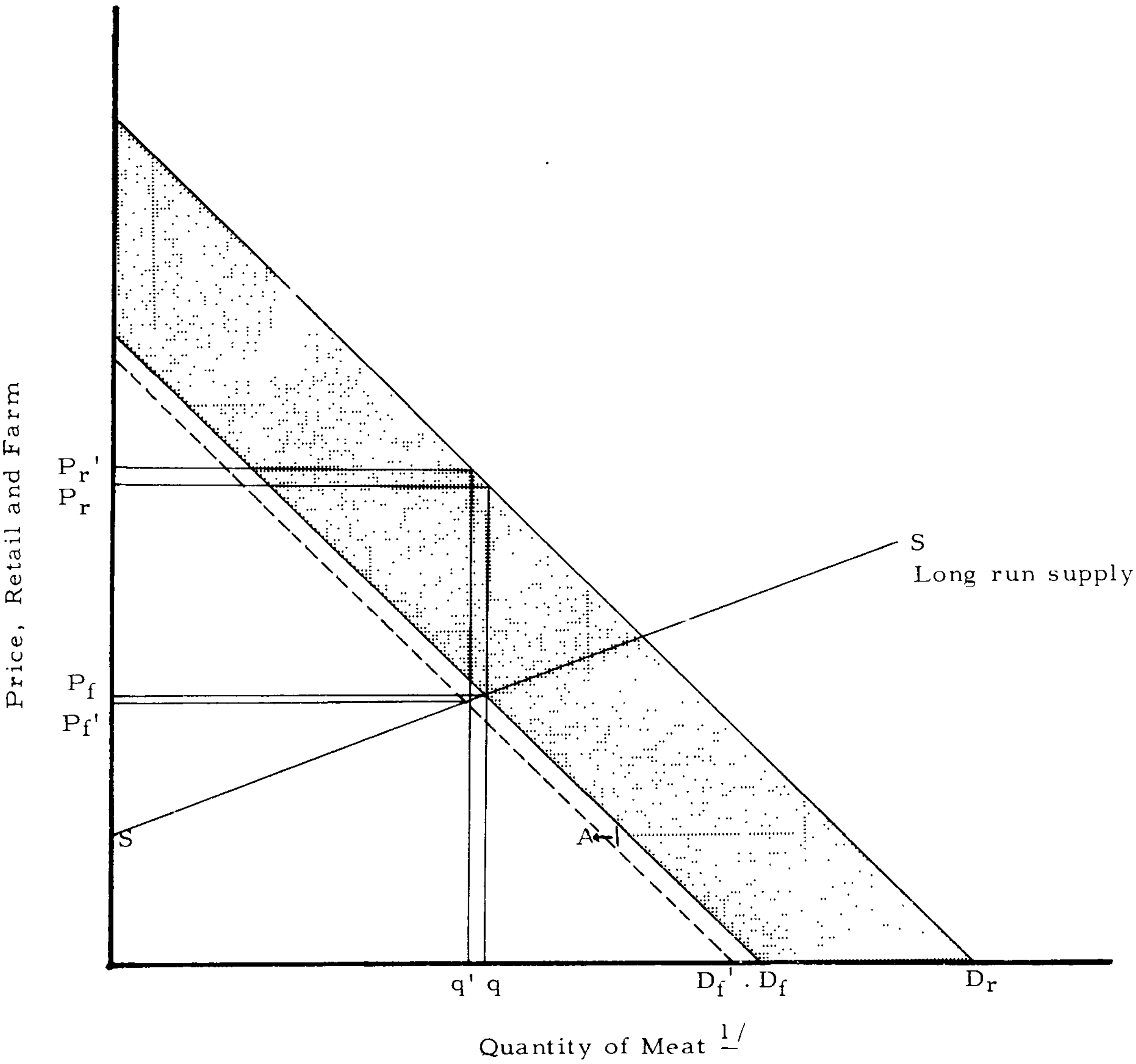
Figure III-4 demonstrates the market response to increasing packing costs. D_r is the aggregate demand curve for red meats at the retail level. D_f is the derived demand curve for red meats at farm level. This curve is obtained from the relationship between farm price and retail price. George and King found the following price relationships using quarterly data:

$$P^{farm}_{beef} = -24.52 + 0.9188\, P^{retail}_{beef} \qquad R^2 = .75$$

$$P^{farm}_{pork} = -21.58 + 0.9014\, P^{retail}_{pork} \qquad R^2 = .90$$

$$P^{farm}_{lamb} = -21.50 + 0.8447\, P^{farm}_{lamb} \qquad R^2 = .76$$

Stronger relationships were not found because farm-retail price margins do not follow in step with the farm prices during the hog cycle and beef cycle. Price spreads tend to narrow during the upturn in prices as



1/ Farm level quantity based on retail cut equivalent, equal to live weight quantity times percent retail cut out of live animal.

Figure III-4. Impact of increased processing costs.

retail price increases lag behind farm price increases. Likewise, when farm prices decline, price spreads increase for the same reason. Beef price spread is $P_{retail} - P_{retail} + 24.52 - 0.9188\ P_{retail}$

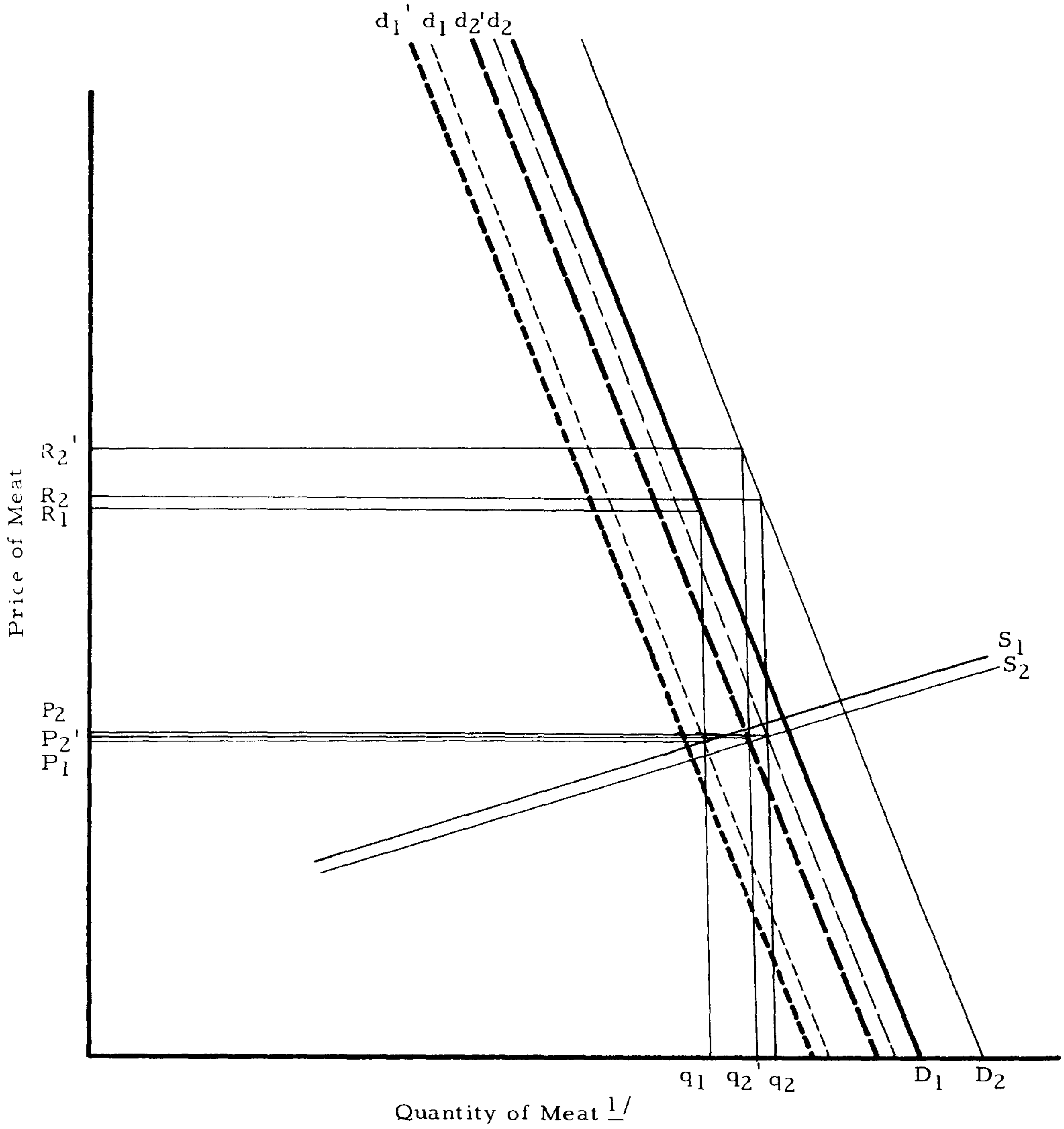
$$\text{Price spread} = 24.52 + 0.0812\ P_{retail}$$

Plotting the price spread on Figure III-5 gives the derived demand for beef, farm level. The supply of meats is determined by at the farm level with increased breeding herds. The long run supply curve (S) reflecting farmers reaction in the long run to changing farm prices for livestock also is shown.

With the imposition of stricter effluent standards, processor costs will increase and are passed on through the wholesaler and retailer to the consumer. This additional cost increases the price spread between farm and retail by a $ per unit and shifts derived demand at farm level down by that amount to D_f. Prior to the new standards, long-run prices and quantity were P_r, P_f and q. The new equilibrium is reached when farm level demand and supply are at the market clearing price P_f'. The resulting quantity consumed and retail price are q' and P_r'. The costs which were not absorbed by the processor resulted in an increase in retail beef price from P_r to P_r' and a decrease in quantity consumed from q to q' and a reduction in farm price to P_f'. The relative impact on farm and retail prices is determined by the elasticity of supply and elasticity of demand. With a more inelastic supply, the price impact will be heavier on farmers and conversely. In the short-run supply is highly inelastic. Then the price impact will be heaviest on the livestock producers. As livestock producers reduce supply in response to this price decline, the cost will be shifted from the farmer to the consumer in the form of higher prices at both farm and retail level. With supply elastic in the long-run, most, but not all, of the cost will be shifted to the consumer. The difference between P_f and P_f' in the long-run case is the price impact on livestock producers.

Instances where industry demand and supply are shifting, the effects illustrated in the stable situation before may not be apparent although still present. Figure III-5 illustrates the case of expanding demand and supply. Retail demand shifts from D_1 to D_2 in going from period 1 to period 2. Supply likewise shifts from S_1 to S_2. The derived demands associated with the retail demand curves are d_1 and d_2 prior to the imposition of stricter water quality standards. Following the imposition they are d_1 and d_2, respectively.

In period one, prior to new standards, quantity, q, is given by the intersection of d_1 and S_1. The retail price is R_1 and the farm price is P_1. With no change in standards the diagram depicts increasing supply and demand and increasing prices resulting from demand shifting



1/ Firm level quantity based on retail cut equivalent, equal to live weight quantity times percent retail cut out of live animal.

Figure III-5. Impact or price of increased processing costs during industry expansion.

faster than supply. Retail price is R_2, farm price is P_2, and quantity is q_2.

Now assume that the new standards are imposed between period 1 and period 2. In going from period 1 to period 2, the derived demand curve shifts from d_1 to d'_2. The new equilibrium quantity q'_2 is greater than q_1 but less than q_2. Farm price, P'_2 is slightly lower than P_2, with no new standards, but is higher than the previous period's price. Retail price rises above the price in the no new standards case. In this situation where demand is increasing faster than supply, the imposition of new water quality standards resulted in higher consumer prices, as expected, but also experienced increasing output and farm prices because the shift in demand was able to more than offset the impact of the standards (d'_2 is to the right of d_1). Thus the ability for the cost to be shifted to the consumer depends upon the rate at which the market situation is changing. During the past two years, consumer demand for meat, stimulated by rising consumer incomes, has outpaced increases in livestock supplies, with the result being rapidly rising livestock and meat prices. Under conditions similar to these, and in the absence of price controls, cost increases associated with water pollution controls would be passed on primarly to the consumer in in the form of higher meat prices.

IV. ECONOMIC IMPACT ANALYSIS METHODOLOGY

The following economic impact analysis utilizes the basic industry information developed in Chapters I-III plus the pollution abatement technology and costs provided by Environmental Protection Agency. The impacts examined include:

- Price effects
- Financial effects
- Production effects
- Employment effects
- Community effects
- Other effects

Due to the crucial nature of potential plant shutdowns (financial and production effects) to the other impacts, a disproportionate amount of time will be devoted to the financial and plant closure analysis.

In general, the approach taken in the impact analysis is the same as that normally done for any feasibility capital budgeting study of new investments. In the simplest of terms, it is the problem of deciding whether a commitment of time or money to a project is worthwhile in terms of the expected benefits derived. This decision process is complicated by the fact that benefits will accrue over a period of time and that in practice the analyst is not sufficiently clairvoyant nor physically able to reflect all of the required information, which by definition must deal with projections of the future, in the cost and benefit analysis. In the face of imperfect and incomplete information and time constraints, the industry segments were reduced to money relationships insofar as possible and the key non-quantifiable factors were incorporated into the analytical thought process to modify the quantified data. The latter process is particularly important in view of the use of model plants in the financial analysis. In practice, actual plants will deviate from the model and these variances will be considered in interpreting financial results based on model plants.

A. Fundamental Methodology

Much of the underlying analysis regarding prices, financial and production effects is common to each kind of impact. Consequently, this case methodology is described here as a unit with the specific impact interpretations being discussed under the appropriate heading following this section.

The core analysis for this inquiry was based upon synthesizing physical and financial characteristics of the various industry segments through model or representative plants. The estimated cash flows for these model plants are summarized in Chapter II. The primary factors involved in assessing the financial and production impact of pollution control are profitability changes, which are a function of the cost of pollution control and the ability to pass along these costs in higher prices. Admittedly, in reality, closure decisions are seldom made on a set of well defined common economic rules, but also include a wide range of personal values, external forces such as the ability to obtain financing or considering the production unit as an integrated part of a larger cost center where total center must be considered.

Such circumstances include but are not limited to the following factors:

1. There is a lack of knowledge on the part of the owner-operator concerning the actual financial condition of the operation due to faulty or inadequate accounting systems or procedures. This is especially likely to occur among small, independent operators who do not have effective cost accounting systems.

2. Plant and equipment are old and fully depreciated and the owner has no intention of replacing or modernizing them. He can continue in production as long as he can cover labor and materials costs and/or until the equipment deteriorates to an irrepairable and inoperative condition.

3. Opportunities for changes in the ownership structure of the plants (or firms) exist through acquisition by conglomerates, large diversified firms, or through other acquisition circumstances which would permit re-evaluation of assets or in situations where new ownership may be willing to accept temporary low returns with the expectation that operations can be returned to profitable levels.

4. Personal values and goals associated with business ownership that override or ameliorate rational economic rules is this complex of factors commonly referred to as a value of psychic income.

5. The plant is a part of a larger integrated entity and it either uses raw materials being produced profitably in another of the firm's operating units wherein an assured market is critical or, alternatively, it supplies raw materials to another of the firm's operations wherein the source of supply is critical. When the profitability of the second operation offsets the losses in the first plant, the unprofitable operation may continue indefinitely because the total enterprise is profitable.

6. The owner-operator expects that losses are temporary and that adverse conditions will dissipate in the future. His ability to absorb short-term losses depends upon his access to funds, through credit or personal resources not presently utilized in this particular operation.

7. There are very low (approaching zero) opportunity costs for the fixed assets and for the owner-operator's managerial skills and/or labor. As long as the operator can meet labor and materials costs, he will continue to operate. He may even operate with gross revenues below variable costs until he has exhausted his working capital and credit.

8. The value of the land on which the plant is located is appreciating at a rate sufficient to offset short-term losses, funds are available to meet operating needs and opportunity costs of the owner-operator's managerial skills are low.

The above factors, which may be at variance with common economic decision rules, are generally associated with proprietorships and closely held enterprises rather than publicly held corporations.

While the above factors are present in and relevant to business decisions, it is argued that common economic rules are sufficiently universal. To provide an useful and reliable insight into potential business responses to new investment decisions, as represented by required investment in pollution control facilities thus, economic analysis will be used as the core analytical procedure. Given the pricing conditions, the impact on profitability (and possible closure) can be determined by simply computing the ROI (or any other profitability measure) under conditions of the new price and incremental investment in pollution control. The primary consequence of profitability changes is the impact on the plant regarding plant shutdown rather than making the required investment in meeting pollution control requirements.

In the most fundamental case, a plant will be closed when variable expenses (Vc) are greater than revenues (R) since by closing the plant, losses can be avoided. However, in practice plants continue to operate where apparently Vc > R. Reasons for this include:

- lack of cost accounting detail to determine when Vc > R.
- opportunity cost of labor or some other resource is less than market values. This would be particularly prevalent in proprietorships where the owner considers his labor as fixed.
- other personal and external financial factors.
- expectations that revenues will shortly increase to cover variable expenses.

A more probable situation is the case where Vc < R but revenues are less than variable costs plus cash overhead expenses (TCc) which are fixed in the short run. In this situation a plant would likely continue to operate as contributions are being made toward covering a portion of these fixed cash overhead expenses. The firm cannot operate indefinitely under this condition, but the length of this period is uncertain. Basic to this strategy of continuing operations is the firm's expectation that revenues will increase to cover cash outlay. Factors involved in closure decisions include:

- extent of capital resources. If the owner has other business interests or debt sources that will supply capital input, the plant will continue.
- lack of cost accounting detail or procedures to know that TCc>R, particularly in multiplant or business situation.
- labor or other resources may be considered fixed and the opportunity cost for these items is less than market value.

Identification of plants where TCc > R, but Vc < R leads to an estimate of plants that should be closed over some period of time if revenues do not increase. However, the timing of such closures is difficult to predict

The next level of analysis, where TCc < R, involves estimating the earnings before and after investment in pollution abatement. So long as TCc < R it seems likely that investment in pollution control will be made and plant operations continued so long as the capitalized value of earnings (CV), at the firms (industry) cost of capital, is greater than the scrap or salvage value (S) of the sunk plant investment. If S > CV, the firm could realize S in cash and reinvest and be financially better off. This presumes reinvesting at least at the firms (industry) cost of capital.

Computation of CV involves discounting the future earnings flow to present worth through the general discounting function:

$$V = \sum_{n=1}^{t} A_n (1+i)^{-n}$$

where

V = present value
A_n = a future value in n^{th} year
i = discount rate as target ROI rate
n = number of conversion products, i.e., 1 year, 2 years, etc.

It should be noted that a more common measure of rate of return is the book rate, which measures the after-tax profits as a ratio of invested capital, is net worth or sales. These ratios should not be viewed as a different estimate of profitability as opposed to DCF measures (discounted cash flow) but rather an entirely different profitability concept. The reader is cautioned not to directly compare the DCF rates with book rates. Although both measures will be reported in the analyses, the book rate is reported for informational purposes only.

The two primary types of DCF measures of profitability are used. One is called the internal rate of return or yield and is the computed discount rate (yield) which produces a zero present value of the cash flow. The yield is the highest rate of interest the investor could pay if all funds were borrowed and the loan was returned from cash proceeds of the investment. The second DCF measure is the net present value concept. Rather than solve for the yield, a discount rate equivalent to the firms cost of capital is used. Independent investments with net present values of above zero are accepted; those below zero are rejected. The concept of comparing capitalized earnings with the sunk investment value is a variation of the net present value method.

The data input requirements for book and DCF measures are derived, to a large extent, from the same basic information although the final inputs are handled differently for each.

1. Benefits

For purposes of this analysis, benefits for the book analysis have been called after-tax income and for the DCF analysis after-tax cash proceeds. The computation of each is shown below:

$$\text{After tax income} = (1 - T) \times (R - E - I - D)$$

$$\text{After tax cash proceeds} = (1 - T) \times (R - E - D) + D$$

where

T = tax rate

R = revenues

E = expenses other than depreciation and interest

I = = interest expense

D = depreciation charges

Interest in the cash proceeds computation is omitted since it is reflected in the discount rate, which is the after-tax cost of capital, and will be described below. Depreciation is included in the DCF measure only in terms of its tax effect and is then added back so that a cash flow over time is obtained.

A tax rate of 48 percent was used throughout the analysis. Accelerated depreciation methods, investment credits, carry forward and carry back provisions were not used due to their complexity and special limitations. It is recognized that in some instances the effective tax rate may be lower in a single plant situation, but with the dominance of multiplant firms, the firm's tax rate will be close to the 48 percent rate.

Revenue, expenses, interest and depreciation charges used were those discussed in Chapter II and Chapter V for pollution control facilities. These items were assumed to constant over the period of analysis.

2. Investment

Investment is normally thought of as outlays for fixed assets and working capital. However, in evaluating closure of an on-going plant where the basic investment is sunk, the value of that investment must be made in terms of its liquidation or salvage value, that is its opportunity cost or shadow price. [1/] For purposes of this analysis, sunk investment was taken as the sum of equipment salvage value plus land at current market value plus the value of the net working capital (current assets less current liabilities) tied up by the plant (see Chapter II for values). This same amount was taken as a negative investment in the terminal year. Replacement investment for plant maintenance was taken as equal to annual depreciation, which corresponds to operating policies of some managements and serves as a good proxy for replacement in an on going business.

Investment in pollution control facilities was taken as the estimates provided by EPA and shown in Chapter V. Only incremental values were used, to reflect in-place facilities.

The above discussion refers primarily to the DCF analysis. Investment used in estimating book rates was taken as invested capital - book value of assets plus net working capital. In the case of new investment, its book rate was estimated as 50 percent of the original value.

3. Cost of Capital - After Tax

Return on invested capital is a fundamental notion in U.S. business. It provides both a measure of actual performance of a firm as well expected performance. In this latter case, it is also called the cost of capital. The cost of capital is defined as the weighted average of the cost of each type of capital employed by the firm, in general terms equities and interest bearing liabilities. There is no methodology that yields the precise cost of capital, but it can be approximated within reasonable bounds.

The cost of equities was estimated by two methods -- the dividend yield method and the earnings stock price (E/P ratio) method. Both are simplifications of the more complex DCF methodology. The dividend method is:

1/ This should not be confused with a simple buy sell situation which merely involves a transfer of ownership from one firm to another. In this instance, the opportunity cost (shadow price) of the investment may take on a different value.

$$k = \frac{D}{P} + g$$

where

k = cost of capital
D = dividend yield
P = stock price
g = growth

and the E/P method is simply

$$k = E/P$$

where

E = earnings
P = stock price

and is a further simplication of the first. The latter assumes future earnings as a level, perpetual stream.

The after tax cost of debt capital was estimated by using estimated 7.5 percent cost of debt and multiplying by .52 -- assuming a 48 percent tax rate. These values were weighted by the respective equity to total asset and total liabilities [1/] to total asset ratios.

The average cost of capital for the meat packing industry was estimated as follows based on various Standard & Poor's industry surveys:

Dividend Yield Plus Growth Method

Capital	Weight	Cost	Growth	Cost
Equity	.61	.026	.04	.041
Debt	.39	.039	--	.015
Average cost of capital				.056

E/P Method

Capital	Weight	Cost	Growth	Cost
Equity	.61	.085	--	.052
Debt	.39	.039	--	.015
Average cost of capital				.067

As shown in the above computations, the estimated after-tax cost is 5.6 to 6.7 percent. The subsequent analysis was based on 6.0 percent. The four percent growth factor is roughly equal to inflation expectations.

1/ It is recognized that liabilities contain non-interest bearing liabilities, but its weight is believed to be an adequate proxy for the weight of debt.

It was assumed that, for the meat packing industry, a pre-tax cost of capital of 11.5 percent was used for evaluating new projects.

4. Construction of the Cash Flow

A thirty-two period cash flow was used in this analysis and was constructed as follows:

1. Sunk investment (salvage market value of fixed assets plus net working capital) taken in year t_o.
2. After tax cash proceeds taken for years t_1 to t_{30}.
3. Annual replacement investment, equal to annual current depreciation taken for years t_1 to t_{30}.
4. Terminal value equal to sunk investment taken in year t_{31}.
5. Incremental pollution control investment taken in year t_o for 1977 standards and year t_6 for 1983 standards.
6. Incremental pollution expenses taken for years t_1 to t_{30} for 1977 standards and years t_7 to t_{30} for 1983 standards.
7. No replacement investment taken on baseline pollution investment on assumption of 30-year useful life.
8. Replacement investment taken on Level I incremental investment in year 25 and on Level II incremental investment in year 21 based on useful lives of 25 and 15 years, respectively.
9. Terminal value of pollution facilities equal to 10 percent of original cost taken in year t_{31}.

B. Price Effects

At the outset, it must be recognized that price effects and production effects are intertwined with one effect having an impact upon the other. In fact, the very basis of price analysis is the premise that prices and supplies (production) are functionally related variables which are simultaneously resolved.

Solution of this requires knowledge of demand growth, price elasticities, supply elasticities, the degree to which regional markets exist, the degree of dominance experienced by large firms in the industry, market concentration exhibited by both the industry's suppliers of inputs and purchasers of outputs, organization and coordination within the industry, relationship of domestic output with the world market, existence and nature of complementary goods, cyclical trends in the industry, current utilization of capacity and, exogenous influences upon price determination (e.g., governmental regulation).

In view of the complexity and diversity of factors involved in determination of the market price, a purely quantitative approach to the problem of price effects is not feasible. Hence, the simultaneous considerations suggested above will be made. The judgment factor will be heavily employed in determining the supply response to a price change and alternative price changes to be employed.

As a guide to the analysis of price effects, the estimated price required to leave the model plant segment as well off will be computed. The required price increase at the firm level will be evaluated in light of the relationship of the model plant to the industry and the understanding of the competitive position of the industry. The required price increase can be readily computed using the DCF analysis described above, but dealing only with the incremental pollution investment and cash proceeds.

Application of the above DCF procedure to these costs will yield the present value of pollution control costs (i.e., investment plus operating cost less tax savings). If this is known, the price increase required to pay for pollution control can readily be calculated by the formula

$$X = \frac{(PVP)\,(100)}{(1-T)\,(PVR)}$$

where:

X = required percentage increase in price

PVP = present value of pollution control costs

PVR = present value of gross revenue starting in the year pollution control is imposed

Note that this formula implies that incremental profits resulting from the price increase will be taxed at a rate of 48 percent.

C. Financial Effects

In Chapter II, the financial characteristics of model plants were presented. These data will serve as the base point for the analysis of financial effects of pollution control. The primary focus of analysis will be upon profitability in the industry and the ability of the firms to secure external capital. Hence, it is obvious that this portion of the analysis cannot be divorced from production effects since profit levels and the ability to finance pollution abatement facilities will have a direct influence on supply responses -- utilization of capacity and plant closures.

The measures of profitability utilized will include after-tax book rate of return on invested capital and cash flow (after-tax profit plus depreciation) will be measured. After-tax profit as a percent of sales will also be reported to assist in comparing financial data with standard industrial measures.

In addition to these factors, two additional measures of economic profitability will also be examined: (1) capitalized value of earnings and (2) present values estimated by the procedures described in Section A above. Both of these measures will be calculated on pre- and post-pollution control bases.

Given these financial measurements, the ability of the industry to finance the required pollution control expenditures will be reexamined in light of the financial results and the information shown in Chapter II. This ability will vary from one industry subsector to another due to differential financial structures, profitability and abatement requirements. Hence, capital availability and cost will probably have to be examined on a model plant by model plant basis.

D. Production Effects

Potential production effects include reductions of capacity utilization rates, plant closures and stagnation of industry growth. It is anticipated that reductions in capacity utilization will be estimated via qualitative techniques given the analysts' knowledge of the industry. The same is true for assessing the extent to which plant closures may be offset by increases in capacity utilization on the part of plants remaining in operation. Data limitations and time constraints are expected to require that the impact of pollution control standards upon future growth of the industry also be estimated via qualitative methods.

The remaining effect, plant closures, is very difficult to measure realistically as discussed above in Section A. As a starting point in the plant closure analysis. a shutdown model will be employed to indicate which model plants should be closed, the marginal operations and the sound operations. These conclusions will be based upon the decision rule that a plant will be closed when the net present value of the cash flow is less than zero.

It is recognized that the use of model plants to represent an industry is imperfect and that not all of the relevant factors can be included in the models. In other words, for any given model plant one would expect to find some actual plants with profits lower and some higher than shown for the model plant. In a statistical sense, one can describe this phenomenon via distribution functions. By examining various publications by Dun and Bradstreet, Inc., we would estimate the industry-wide standard deviation of net profit as a percent of sales at 1.0 if normality is assumed. However, the industry-wide distribution appears to have a definite skew to the right. We feel this shewness is explained by the fact that a large portion of the industry is composed of packinghouses which generally show higher than median profits. If one were to segment the industry and estimate the distribution for each size category in each segment, we feel the results would closely approximate normality.

For the purpose of analyzing financial and plant closure effects, the distribution of net present value (discounted) as a percent of sales was examined. It was assumed that this distribution was normal for each of the model plants. As a starting point it was noted that the 1.0 standard deviation of net profits as a percent of sales would equal 13.8 if multiplied by the 6 percent annuity factor for 30 years. Of course, annual profits for an actual plant vary temporarily and a large part of the variation is due to plant type and size variations.

Defining the median for the distribution as being the model plant's net present value (assuming primary effluent treatment) divided by animal sales and utilizing published data and data in the contractor's files, the standard deviation of net present value divided by sales was estimated as 0.3 times the median. This methodology implicitly assumes that the model plant represents the median plant for the distribution and that there will be a different standard deviation associated with each model plant. Furthermore, the procedure implies that the standard deviation will be larger for the more profitable industry segments. By utilizing the net present values calculated under alternative effluent treatment assumptions, the standard deviations described above and the assumption that plants with a negative ratio for net present value divided by sales will be forced to close, the percentage of firms closing in each industry segment can be readily estimated through accepted statistical techniques.

E. Employment Effects

Given the production effects of estimated production curtailments, plant closings and changes in industry growth, a major consideration arises in the implications of these factors upon employment in the industry. The employment effects stemming from each of these production impacts will be estimated. To the extent possible, the major employee classifications involved will be examined as will the potential for re-employment.

F. Community Effects

The direct impacts of job losses upon a community are immediately apparent. However, in many cases, plant closures and cutbacks have a far greater impact than just the employment loss. Multiplier effects may result in even more unemployment. Badly needed taxes for vital community services may dwindle. Community pride and spirit may be dampened. However, in some cases, the negative community aspects of production effects may be very short-term in nature with the total impact barely visible from the viewpoint of the overall community. In a few cases, the closure of a plant may actually be viewed as a positive net community effect (e.g., a small plant with a high effluent load in an area with a labor shortage).

These impact factors will be qualitatively analyzed as appropriate.

G. Other Effects

Other impacts such as direct balance of payments effects will also be included in the analysis. This too will involve qualitative analyses.

V. EFFLUENT CONTROL COSTS

Water pollution control costs used in this analysis were furnished by the Effluent Guidelines Division of the Environmental Protection Agency from materials developed in part for the the Environmental Protection Agency by North Star Research Institute.[1/] These basic data were adapted to the types and sizes of slaughter plants and packinghouses specified in this analysis.

Three effluent guidelines were considered:

BPT	-	Best Pollution Control Technology Currently Available, to be achieved by July 1, 1977
BAT	-	Best Available Pollution Control Technology Economically Achievable, to be achieved by July 1, 1983
NSPS	-	New Source Performance Standards, apply to any source for which construction starts after the publication of the proposed regulations for the Standards

A technical document describing the recommended technology for achieving the three guidelines will be published as a separate report by EPA. To avoid duplication and possible confusion, no technical descriptions of BPT, BAT and NSPS guidelines are given in this report. The interested reader is referred to EPA's technical report for technology descriptions.

1/ Development Document for Effluent Limitations Guidelines and Standards of Performance -- Meat Packing Industry, Draft Report, North Star Research Institute, June, 1973.

EPA provided effluent treatment costs for four "typical" plants:

1. "Simple" slaughterhouse - kills 484,000 pounds liveweight basis per day. Does a very limited amount of processing of by-products (i.e., secondary processing). Usually, no more than two secondary processes, such as rendering, paunch and viscera handling, blood processing or hide or hair processing are carried out.

2. "Complex" slaughterhouse - kills 1,310,000 pounds liveweight basis daily. Does extensive processing of by-products (i.e., secondary processing). It usually carries out at least three of the secondary processes listed above.

3. "Low-processing" packinghouse - kills 900,000 pounds liveweight basis daily. Normally processes less than the total animals killed at the site but may process up to the total killed.

4. "High-processing" packinghouse - kills 800,000 pounds liveweight basis daily. Normally processes both the total kill at the site and additional carcasses from outside sources.

Baseline Effluent Control Costs

Effluent control costs for each of the three treatment levels were based upon an assumption that baseline pre-BPT treatment included primary and secondary systems represented as removal of settleable solids and grease plus anaerobic and aerobic lagoons. Baseline costs for this assumed existing treatment system are shown in Table V-3.

Incremental Effluent Control Costs

Given the baseline effluent control costs shown in Table V-3, which were assumed to be in place for the "typical" plants specified, estimates were given for the incremental costs required to achieve effluent controls adequate to meet BPT and BAT guidelines for the four "typical" plants (Table V-4). Costs for meeting NSPS guidelines are assumed to equal BPT costs until 1983 at which time they will equal BAT costs.

Table V-3. Baseline effluent control costs for "typical" types of slaughterhouses and meat packinghouses, 1971 costs

Cost Item	Simple slaughterhouse 121 mill lbs. lwk.	Simple slaughterhouse 328 mill. lbs. lwk.	Low-process packinghouse 225 mill. lbs. lwk.	High-process packinghouse 200 mill. lbs. lwk.
Investment	$238,000	$425,000	$400,000	$475,000
Annual Cost	53,300	85,600	80,700	93,500
Capital	23,800	42,500	40,000	47,500
Depreciation	8,800	15,300	14,500	16,900
Operating cost	20,700	27,800	26,200	29,100

Source: Development Document for Effluent Limitation Guidelines and Standards of Performance Meat Packing Industry, Environmental Protection Agency, June, 1973.

Table V 4. Incremental effluent control costs for "typical" types of slaughterhouses and meat packinghouses, 1971 costs

Effluent control level	Cost Item	Simple slaughterhouse 121 mill. lbs. lwk.	Complex slaughterhouse 328 mill. lbs. lwk.	Low-process packinghouse 225 mill. lbs. lwk.	High-Process packinghouse 200 mill. lbs. lwk.
BPT	Investment	$80,000	$139,000	$131,000	$14[illegible],000
	Annual Cost	19,360	39,360	33,750	42.000
	Capital	8,000	13,900	13,100	14,800
	Depreciation	3,200	5,560	5,240	5,920
	Operating Cost	8,160	19,900	15,410	21,280
BAT	Investment	425,000	665,000	629,000	736,000
	Annual Cost	160,930	285,360	249,750	306,000
	Capital	42,500	66,500	62,900	73,600
	Depreciation	27,800	42,660	39,940	47,620
	Operating Cost	90,630	176.200	146.910	184,780
NSPS	Same as BPT - The effluent treatment costs for new sources is assumed to be the same as that for the Best Practicable Control Technology Currently Available.				

Source: Development Document for Effluent Limitation Guidelines and Standards of Performance Meat Packing Industry Environmental Protection Agency June, 1973

Modified Costs - Effluent Control Systems

The effluent control costs provided by EPA were "single point" estimates in that they applied specifically to a given type of plant with a given annual liveweight kill volume. Obviously, effluent treatment costs will vary with wasteflow and, hence, processing volume. Based on discussions with EPA and North Star Research Institute personnel, DPRA estimated investment and annual treatment cost data for alternative plant sizes. These estimates were made by assuming that, for a given treatment level, both investment and operating costs were a junction of quantity of wasteflow. Given that assumption, each of the four "typical" plants were plotted on a graph and a smooth curve was drawn to "fit" the points. Although the points representing the "typical" plants do not fall precisely on the line, it is believed that the fit is acceptable. However, a matter of concern is that the four "typical" plants, specified in the technical report, all had wasteflows exceeding 0.3 million gallons per day while four of DPRA's model plants have flows of less than 0.2 million gallons per day. The extrapolations required to estimate costs for those plants adds to the possible analytical error in the analysis of small plants.

Having developed baseline and incremental treatment costs for BPT and BAT controls, it was then necessary to add these costs to get "total" control costs.

Since the cost data provided to DPRA were based on 1971 costs, they were updated to 1972 levels by using appropriate inflators (i.e., Index of Sewage Treatment Plant Construction Cost for investment and the Implicit Price Inflator for GNP for operating costs).

The cost estimates obtained through the procedures described above are shown in Tables V-5 through V-9. Figure V-1 shows the relationship between wastewater flows and effluent control investment costs for the baseline case and control levels BPT and BAT.

Current Status of Effluent Control in the Industry

Limited information was available concerning the current status of effluent treatment and control in the meat industry.

1. Discharge into municipal or other publicly-owned wastewater treatment systems

There are no recent publications with reliable estimates of the proportion

Table V-5. Baseline effluent control costs - 1972

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$256,000	$401,000	$289,000	$109,000
Total annual cost	56,400	88,300	63,800	24,000
Capital	25,600	40,100	28,900	10,900
Depreciation	9,500	14,800	10,700	4,000
Operating	21,300	33,400	24,200	9,100
B. Complex slaughterhouse				
Investment	457,000	457,000	341,000	134,000
Total annual cost	90,800	90,800	67,600	26,500
Capital	45,700	45,700	34,100	13,400
Depreciation	16,500	16,500	12,300	4,800
Operating	28,600	28,600	21,200	8,300
C. Low-process packinghouse				
Investment	430,000	466,000	350,000	141,000
Total annual cost	85,600	92,900	69,700	28,200
Capital	43,000	46,600	35,000	14,100
Depreciation	15,600	16,900	12,700	5,100
Operating	27,000	29,400	22,000	9,000
D. High-process packinghouse				
Investment	511,000	550,000	429,000	170,000
Total annual cost	99,300	107,000	83,400	33,000
Capital	51,100	55,000	42,900	17,000
Depreciation	18,200	19,600	15,300	6,000
Operating	30,000	32,400	25,200	10,000

Table V-6. BPT, incremental effluent control costs, above baseline, 1972 costs

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$ 86,000	$132,000	$ 92,000	$ 37,000
Total annual cost	20,500	31,300	21,800	8,900
Capital	8,600	13,200	9,200	3,700
Depreciation	3,200	5,000	3,400	1,400
Operating	8,700	13,100	9,200	3,800
B. Complex slaughterhouse				
Investment	$150,000	148,000	110,000	44,000
Total annual cost	41,600	41,000	30,500	12,100
Capital	15,000	14,800	11,000	4,400
Depreciation	5,700	5,600	4,200	1,700
Operating	20,900	20,600	15,300	6,000
C. Low-process packinghouse				
Investment	141,000	151,000	117,000	47,000
Total annual cost	35,700	38,100	29,600	11,900
Capital	14,100	15,100	11,700	4,700
Depreciation	5,300	5,600	4,400	1,700
Operating	16,300	17,400	13,500	5,500
D. High-process packinghouse				
Investment	159,000	174,000	140,000	56,000
Total annual cost	44,100	48,400	38,300	15,600
Capital	15,900	17,400	14,000	5,600
Depreciation	6,100	6,700	4,800	2,200
Operating	22,100	24,300	19,500	7,800

Table V-7. BAT, Incremental effluent control costs, above baseline, 1972 costs

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$457,000	$642,000	$473,000	$192,000
Total annual cost	168,900	237,000	174,600	71,100
Capital	45,700	64,200	47,300	19,200
Depreciation	29,200	41,000	30,200	12,400
Operating	94,000	131,800	97,100	39,500
B. Complex slaughterhouse				
Investment	716,000	709,000	561,000	221,000
Total annual cost	299,100	296,400	234,300	92,300
Capital	71,600	70,900	56,100	22,100
Depreciation	45,800	45,400	35,800	14,100
Operating	181,700	180,100	142,400	56,100
C. Low-process packinghouse				
Investment	677,000	721,000	462,000	233,000
Total annual cost	261,500	279,100	200,600	90,300
Capital	67,700	72,100	46,200	23,300
Depreciation	27,800	46,200	32,800	14,900
Operating	166,000	160,800	121,600	52,100
D. High-process packinghouse				
Investment	792,000	826,000	675,000	267,000
Total annual cost	320,800	334,600	273,300	108,100
Capital	79,200	882,600	67,500	26,700
Depreciation	50,700	52,900	43,100	17,100
Operating	190,900	199,100	162,700	64,300

Table V-8. BPT, total effluent control costs, 1972 basis

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$342,000	$533,000	$381,000	$146,000
Total annual cost	76,900	119,600	85,600	32,900
Capital	34,200	53,300	38,100	14,600
Depreciation	12,700	19,800	14,100	5,400
Operating	30,000	46,500	33,400	12,900
B. Complex slaughterhouse				
Investment	507,000	605,000	451,000	178,000
Total annual cost	132,400	131,800	98,100	38,600
Capital	60,700	60,500	45,100	17,800
Depreciation	22,200	22,100	16,500	6,500
Operating	49,500	49,200	36,500	14,300
C. Low-process packinghouse				
Investment	571,000	617,000	467,000	188,000
Total annual cost	121,300	131,000	99,300	40,100
Capital	57,100	61,700	46,700	18,800
Depreciation	20,900	22,500	17,100	6,800
Operating	43,300	46,800	35,500	14,500
D. High-process packinghouse				
Investment	670,000	724,000	569,000	226,000
Total annual cost	143,400	155,400	121,700	48,600
Capital	67,000	72,400	56,900	22,600
Depreciation	24,300	26,300	20,100	8,200
Operating	52,100	56,700	44,700	17,800

Table V-9. BAT, total effluent control costs, 1972 basis

Cost Item	EPA	DPRA Large	DPRA Medium	DPRA Small
A. Simple slaughterhouse				
Investment	$ $713,000	$1,043,000	$762,000	$301,000
Total annual cost	225,300	325,300	238,400	95,100
Capital	71,300	104,300	76,200	30,100
Depreciation	38,700	55,800	40,900	16,400
Operating	115,300	165,200	121,300	48,600
B. Complex slaughterhouse				
Investment	1,173,000	1,166,000	902,000	355,000
Total annual cost	389,900	387,200	301,900	118,800
Capital	117,300	116,600	90,200	35,500
Depreciation	62,300	61,900	48,100	18,900
Operating	210,300	208,700	163,600	64,400
C. Low-process packinghouse				
Investment	1,107,000	1,187,000	928,000	374,000
Total annual cost	347,100	372,000	293,500	118,500
Capital	110,700	118,700	92,800	37,400
Depreciation	43,400	63,100	49,700	20,000
Operating	193,000	190,200	151,000	61,100
D. High-process packinghouse				
Investment	1,303,000	1,376,000	1,104,000	437,000
Total annual cost	420,100	441,600	356,700	141,100
Capital	130,300	137,600	110,400	43,700
Depreciation	68,900	72,500	58,400	23,100
Operating	220,900	231,500	187,900	74,300

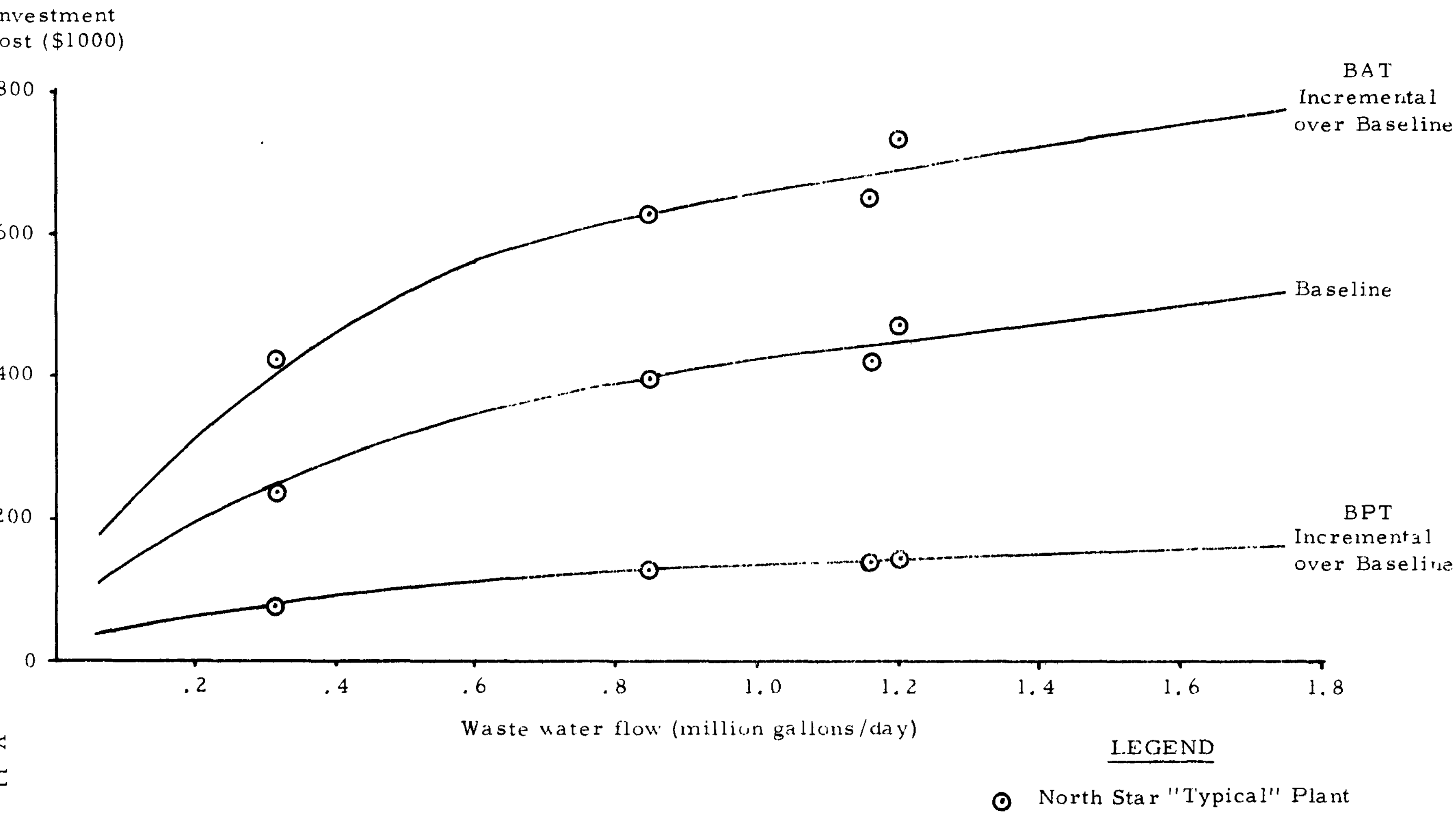


Figure V-1. Baseline, BPT and BAT Effluent Control Investment Costs in 1971 Dollars.

of meat plants which discharge to municipal sewers. The guidelines analyzed herein apply only to direct discharges. Hence, it was necessary to divide the industry into municipal dischargers and direct dischargers. The best information attainable within the limitations imposed upon this study was based upon surveys conducted by North Star Research Institute for the Environmental Protection Agency. The estimates are as follows:

Plant Type	Municipal Dischargers	Direct Dischargers
	(%)	(%)
Simple Slaughterhouse	56	44
Complex Slaughterhouse	29	71
Low-process Packinghouse	70	30
High-process Packinghouse	59	41

When referencing all packinghouses collectively, the average of low-process and high-process percentages was used--64 percent.

2. Primary treatment systems

Virtually all plants have primary treatment systems to remove settleable solids and a large part of the grease. No constituents of the effluent discharge of meat plants were reported which would interfere, pass through, or otherwise be incompatible with a well-designed and operated publicly-owned wastewater treatment plant.

Based on a survey of 85 plants, conducted by North Star Research Institute for EPA, it was found that dissolved air flotation is used as a primary treatment, either alone or with screens or a catch basin, by about 30 percent of the plants in the sample. A higher proportion of slaughterhouses had air flotation systems than was true for packinghouses.

3. Secondary treatment systems

The survey of plants showed the following secondary treatment systems for the plants in the sample.

Type of plant	Type of secondary treatment			
	Municipal (%)	Anaerobic + aerobic lagoons (%)	Other (%)	Total (%)
Simple slaughterhouse	56	33	11	100
Complex slaughterhouse	29	65	6	100
Low-process packing-house	70	11	19	100
High-process packing-house	59	14	27	100
All plants	55	28	17	100

This sample distribution shows the major type of treatment to be municipal systems, except for the complex slaughterhouse category. It appears significant that this category utilizes lagoon systems to a much greater degree (more than double) than do other types of plants many of the complex slaughterhouse plants are large scale, kill and chill operations which tend to be newer plants located in the country adjacent to major feeding areas.

A further estimate, based on the plant survey, indicates the relative importance of lagoons in relation to the estimated percent of industry flow treated in 1971, as follows:

Type of plant	Percent of industry flow treated by anaerobic and aerobic lagoons (%)
Simple slaughterhouse	75
Complex slaughterhouse	90
Low-process packinghouse	40
High-process packinghouse	35

Again the greater relative importance of lagoon systems for treatment of slaughterhouse effluents is apparent.

For the purpose of this analysis, it was assumed that all direct discharges currently have baseline treatment systems in place. Results of the plant survey plus discussions with industry specialists indicate this is a reasonable assumption. It is recognized that a few plants still only have primary treatment systems (probably less than 5 percent of the direct dischargers) but, it is believed those plants are probably older and less efficient and would be forced to close operations in the next few years due to competitive market forces not related to effluent treatment guidelines.

VI. IMPACT ANALYSIS

The imposition of effluent controls on the livestock slaughtering and meat packing industry will have both direct and indirect impacts on the industry, on consumers, on its suppliers and on communities in which plants are located. An analysis was made, for specified effluent control levels, in both quantitative and qualitative terms, of the impacts which are expected.

The following types of impacts have been analyzed:

A. Price Effects
B. Financial Effects
C. Production Effects
D. Employment Effects
F. Community Effects
G. Balance-of-Payment Effects

A. Price Effects

As will be seen in the following section of this report, the role of price effects in this analysis is critical. The meat packing industry is one with a low value added and a very low profit margin in relation to sales. A small change in the wholesale meat price with live animal prices staying constant results in substantial changes in industry profits. The converse of this argument is likewise true. Hence, if even a small increase in packer margins can be expected as a result of mandatory effluent treatment practices, the adverse economic impacts of those controls on the industry will, be ameliorated or, possibly, eliminated. We expect this to be the case in the long run under BPT guidelines. However, the situation under BAT guidelines is less encouraging.

1. Long Run Effects

The theoretical considerations involved in analyzing price effects were presented earlier and, for brevity, will not be repeated at this point. However, three critical points should be recalled. First, historical price movements at the farm and retail level have been highly correlated --

indicating that packers have little control over price at either level. Second, the farm level demand for beef is derived from the consumer demand at retail. If packers could act in unison, they could effectively shift the derived farm demand curve to the left while the consumer demand curve remained constant. The seemingly inconsistent viewpoints are partially explained by the third point. If consumer demand is shifting to the right (e.g. due to population increases or income elasticity effects) and the long run supply curve is also shifting to the right (e.g. due to technological advances), increases in packer margins may be partially masked with both consumer and farm prices increasing. However, the primary reason packers cannot control price margins is due to the competitive nature of the industry. As noted earlier, the market power of the old giant packers has been eroding. Given the current and anticipated number and diversity of firms in the industry, collective actions to control long run margins would surely be futile. Ironically, it is this very characteristic which makes margin increases likely in the long run under BPT controls.

The incremental costs of BPT treatment described above are very small when compared to sales volume -- less than 0.2 percent for each of the model plants (Table VI-1).[1/] As a result, the expected number of plant closures attributable to BPT guidelines are insignificant. The capacity lost due to such closures could easily be absorbed by the remaining plants.

Even though closures would not reduce capacity sufficiently to induce price changes, the normal forces of the market system would tend to allow margins to widen enough to cover BPT effluent treatment costs for large plants in the long run (assuming production technology remains constant). The average wholesale price increase required to cover BPT treatment in the large plants would run about 0.05 percent, such a small price change would be most difficult to trace through the market system. However, we feel the initial price response would develop as a result of decreased competition for live animals -- packers will try to maintain current profits by paying less for live animals. The ability of packers to lower live prices will depend partially upon the hog and cattle cycles. We feel a price change at the farm level would be more likely when livestock available for slaughter are increasing. A price reduction at the farm level would encourage farmers to reduce livestock production which, eventually, will mean consumers would find meat a little less plentiful and a little more expensive.

1/ Treatment costs as a percent of sales is calculated on the basis of a 32 year cash flow (30 years of operation) with both treatment costs and revenues discounted back to year zero prior to calculating the percentage.

Table VI-1. Price change required to pay for incremental pollution control*

	Level I above Baseline	Level II above Baseline	Level II above Level I
Simple beef slaughter			
Small	0.13	1.07	0.94
Medium	0.06	0.43	0.37
Complex beef slaughter			
Medium	0.07	0.59	0.52
Large	0.05	0.37	0.32
Simple beef-hog slaughter			
Small	0.15	1.24	1.09
Medium	0.07	0.50	0.43
Complex beef-hog slaughter			
Medium	0.09	0.68	0.59
Large	0.06	0.43	0.37
Low-process packinghouse			
Small	0.14	1.07	0.93
Medium	0.06	0.38	0.32
Large	0.04	0.28	0.24

* Price change is calculated as treatment costs as a percent of sales where a 32 year cash flow (30 years of operation plus 1 year for start-up and 1 year for shut-down) is used and both treatment costs and revenues are discounted back to year zero prior to calculating the percentage.

Up to this point, the implication has been that all firms in the industry will face identical standards. That does not appear to be the case. Plants connected to municipal sewers are not included in the standards to which this report is addressed. However, we do know of several plants where substantial pre-treatment facilities are in place or being planned. In addition, those same firms are sharing the cost burden of the municipal treatment system. We anticipate municipal effluent treatment systems to be upgraded and, hence, more costly to the user. Also, we expect pre-treatment requirements to be applied in more cases. In that regard, it is useful to note that the slaughter of a 1,000 pound steer in a simple slaughter plant generates a wasteflow of 639 gallons compared to per capita household wasteflow of about 75-100 gallons. The wasteflow of a large simple slaughter plant would probably equal that of a residential community of 7,000 people (assuming no business establishments were included in the community). Alternatively, the same plant's wasteflow would probably equal the total flow of a typical town of about 3,500 population. For a high-process packinghouse, the population equivalents would be over twice as large as the simple slaughterhouse.

Realizing that meat packing plants connected to sewers will incur a treatment cost and that those plants are reported by North Star to represent more than 50 percent of the industry, their influence on price determination cannot be ignored. If their treatment costs are lower, new plants would, in most cases, locate where sewers were available, price increases would be smaller, and a disproportional number of non-sewered plants would close. If their costs were higher, the reverse trends would be expected. Hence, to complete the price analysis, an assumption about treatment costs for sewered plants had to be made. Economies of scale would suggest municipal treatment costs should be lower than private treatment costs.

Federal subsidies of municipal plants would also tend to favor the sewered plants. However, municipal plants in small towns and cities often aren't designed solely from an economic point of view. Municipal capacity in such communities often exceeds wasteflow by a factor of 2 or more -- sometimes as high as 4. Hopes for growth, politics, and a whole host of other factors may enter into the design and operation of municipal plants. Hence, some would argue that municipal costs would be higher than private treatment costs. North Star indicates that position in their draft report. In view of the absence of adequate data to justify another position, we have assumed that municipal treatment (plus any required pretreatment) will equal private industrial treatment costs in 1977. It is further assumed that the current market price reflects the baseline condition (anaerobic + aerobic lagoons) and that the baseline cost equals currently prevailing treatment costs for sewered plants. Finally, it is assumed that municipal treatment costs in 1983 will equal 1977 costs and, hence, will be less expensive than BAT treatment costs.

For those plants not discharging to municipal sewers, we feel a weighted average red meat wholesale price increase of 0.3 percent should cover the incremental cost of BAT treatment. However, it is unlikely that such a price change would prevail in the long run. About 55 percent of the plants are connected to municipal sewers. Except for possibily a few isolated areas, the competitive power of those plants should be sufficient to hold margins down to the levels expected with BPT treatment. Those firms requiring private treatment systems will be forced to close or absorb the added cost of BAT treatment. New firms faced with NSPS guidelines in 1983 would find an added inducement to locate in areas where they could hook-up to municipal treatment systems.

2. Short Run Effects

The short run impact of pollution controls may differ substantially from the long run impacts. NSPS guidelines would require new plants to meet the BPT guideline for existing plants. The BPT guideline implicitly requires the baseline installation. For firms currently at baseline treatment, BPT should not pose a serious problem in most cases. As we see it, however, BPT would influence closure of some plants which will require substantial rejuvination prior to 1983 due to obsolescence. In those cases, the combined effect of remodeling plus BPT treatment may be excessive in view of anticipated profits.

With BPT controls in place, new small plants could probably only be justified in unusual circumstances where the possibility of exercising market power is greater than what typically exists in the industry. Most new plants would probably be of the medium and large categories with a high proportion engaged in processing. Plants dropping out would most likely be small -- especially small slaughter plants. Hence, economies of scale experienced in waste treatment would tend to dampen price effects once the new plants were operational.

The short run effects starting in 1982 or 1983 as a result of BAT guidelines should be larger than the long run effects. How much larger depends upon the psychological reaction of the industry to the standards and technology proposed. If the standards are viewed as totally unrealistic and the technology as unproven and impractical, the short run closures and price effects could be very large when compared to the expected long run impacts. At this point in time and within the scope of this study, the extent to which such a reaction might prevail cannot be ascertained.

With the existing economies of scale plus the substantial economies of scale reported above for waste treatment, large short run effects could vastly alter the structure of the industry. Slaughter only plants would be placed at a disadvantage as would smaller plants. Unless these projected economies are offset by increased transportation costs, differential wage rates, etc., an excessive short run disequilibrium could mark the entrance of plants two to three times the size we report as large in 1973 and a substantial reduction of competition in the industry.

Our long run analysis has been based upon the assumption that a massive short run adjustment will not occur. If such an adjustment did materialize as a result of BAT, our long run analysis could be in error. Closures of small and medium plants would be larger than predicted. A few large firms gained substantial market power, the decreased competition might also result in an increase in the long run price level.

B. Financial Effects

In order to measure the financial impacts of proposed effluent controls on the livestock slaughter and meat packing industry, income rates of return and cash flows were calculated for various sizes and types of model plants with and without effluent control costs. Rates of return were calculated on average fixed investment and on sales. Analyses made include the following:

1. Pre-tax net income
2. Pre-tax rate of return on average invested capital
3. After-tax rate of return on average invested capital
4. After-tax rate of return on sales
5. Estimated cash flow as a percent of average invested capital
6. Estimated annual cash flows.

1. Pre- Tax Net Income

The impact of alternative effluent treatment levels on specified types and sizes of model livestock slaughter plants and meat packinghouses is shown in Table VI-2. In general, imposition of BPT controls result in a moderate reduction and BAT controls impact severely on incomes.

Slaughter plants are hit harder than packinghouses and small plants show greater relative reductions in income than do larger plants. The relative income impacts are as follows:

Type and size of plant	Percent reduction from "baseline" income	
	BPT (%)	BAT (%)
Simple beef slaughter		
Small	26	183
Medium	5	46
Complex beef slaughter		
Medium	9	73
Large	6	45
Simple beef-hog slaughter		
Small	15	120
Medium	7	54
Complex beef-hog slaughter		
Medium	9	71
Large	6	41
Low-process packinghouse		
Small	10	72
Medium	4	24
Large	2	15

2. Pre-Tax Rate of Return on Average Invested Capital

Pre-tax rate of return on average invested capital for specified types and sizes of plants as affected by alternative effluent control levels is shown in Table VI-3. The impact of effluent control costs operates in the same way as was the case for pre-tax income.

Table VI-2. Pre-tax net income for model meat packing plants, alternative effluent treatment levels, assuming no price change

	Baseline	BPT	BAT
	($000)	($000)	($000)
Simple beef slaughter			
Small	35	26	-29
Medium	315	299	170
Complex beef slaughter			
Medium	322	292	88
Large	651	609	355
Simple beef-hog slaughter			
Small	59	50	-12
Medium	322	301	148
Complex beef-hog slaughter			
Medium	330	300	96
Large	720	678	424
Low-process packinghouse			
Small	125	113	35
Medium	846	816	645
Large	1,998	1,960	1,704

Table VI-3. Pre-tax rate of return on average invested capital for model meat packing plants, alternative effluent treatment levels, assuming no price change

	Baseline	BPT	BAT
	(%)	(%)	(%)
Simple beef slaughter			
Small	8.0	6.2	0
Medium	14.0	12.9	7.3
Complex beef slaughter			
Medium	14.1	12.7	4.5
Large	15.9	14.7	8.6
Simple beef-hog slaughter			
Small	12.0	10.2	0
Medium	14.4	13.3	6.7
Complex beef-hog slaughter			
Medium	14.5	13.1	4.9
Large	18.2	16.9	10.4
Low-process packinghouse			
Small	10.9	9.7	3.1
Medium	16.5	15.8	12.3
Large	21.7	21.1	18.0

Imposition of BPT controls reduces the rate of return somewhat and BAT controls reduce rates of return to near or below zero for small model plants.

BPT controls reduce returns, over the Baseline case, by nearly 2 percent for small plants, 1 - 1.5 percent for medium sized plants and 0.5 to 1.0 percent for large plants.

BAT controls have substantial impacts on returns of small plants, dropping returns by 5 percent or more. Medium and large model slaughter plant returns are reduced by about 6 percent and medium and large packinghouse returns drop by about 3 percent.

3. After-Tax Return on Average Invested Capital

After-tax returns on average invested capital are shown in Table VI-4. Returns are relatively low even in the baseline situation. BPT controls reduce returns somewhat and BAT controls reduce after-tax returns to less than 6 percent for all slaughter plants and for small packinghouses. Only medium and large packinghouses have after-tax returns exceeding 6 percent with BAT controls in place.

4. After-Tax Return on Sales

The meat packing and livestock slaughter industry normally operates on after-tax returns on sales of one-half to one and one-half percent. Table VI-5 presents model plant after-tax returns on sales for alternative effluent control levels. With baseline controls in place, returns for slaughter only plants average near 0.5 percent and packinghouses average near 1.0 percent. Imposition of BPT controls reduces returns on sales only a small amount. BAT controls reduce returns on sales for all slaughter plants to extremely low (0.33 or lower) levels. Packinghouses survive fairly well with BPT controls in place, but BAT controls have a substantial impact on the small plants.

5. Estimated Cash Flow as a Percent of Average Invested Capital

Estimated cash flows on average invested capital for the model meat packing plants are shown in Table VI-6. In the baseline case, simple slaughter plants have cash flows percentages nearly equal complex plants of the same size and specie. The ratios are slightly more favorable for the combined beef-hog plants than for beef only. However, in actual practice, most hogs are cut and processed by the same firm that does the slaughter. Also, most hog carcasses that are sold

Table VI-4. After-tax return on average invested capital for model meat packing plants, alternative effluent treatment levels, assuming no price change

	Baseline	BPT	BAT
	(%)	(%)	(%)
Simple beef slaughter			
Small	4.1	3.3	< 0
Medium	7.3	6.7	3.8
Complex beef slaughter			
Medium	7.3	6.6	2.3
Large	8.3	7.7	4.5
Simple beef-hog slaughter			
Small	6.3	5.5	< 0
Medium	7.5	7.0	3.5
Complex beef-hog slaughter			
Medium	7.5	6.7	2.4
Large	9.5	8.9	5.5
Low-process packinghouse			
Small	5.7	5.1	1.7
Medium	[illegible]	9.2	5.4
Large	11.3	11.0	[illegible]

Table VI-5. After-tax return on sales for model meat packing plants, alternative treatment levels, assuming no price change

	Baseline	BPT	BAT
	(%)	(%)	(%)
Simple beef slaughte			
Small	0.28	0.21	<0
Medium	0.43	0.40	0.23
Complex beef slaughter			
Medium	0.44	0.40	0.12
Large	0.45	0.42	0.24
Simple beef-hog slaughter			
Small	0.56	0.48	<0
Medium	0.52	0.48	0.25
Complex beef-hog slaughter			
Medium	0.52	0.47	0.15
Large	0.57	0.53	0.33
Low-process packinghouse			
Small	0.80	0.73	0.24
Medium	0.94	0.91	0.72
Large	1.11	1.08	0.94

by formula pricing. Hence, we may have reflected a small portion of the processing margin in the carcass price when estimating the typical formula price (wholesale prices of whole hog carcasses are not published). The cash flows are higher for processing than for slaughter as is generally acknowledged in the industry. Cash flow percentages vary by size within a segment but, not excessively.

BPT and BAT controls reduce the cash flows. Although the BPT cash flows are only slightly smaller than baseline, the BAT impact is substantial if no price increases are assumed.

6. Estimated Annual Cash Flows

Estimated cash flows in dollars appear in Table VI-7. These data verify the conclusions reached with respect to the percentages shown in Table VI-6. Also, the grossly differential impacts of BAT treatment requirements can be readily seen when dollar cash flows are examined. The percentage reduction from baseline to BAT ranges from 6 percent for the large packinghouse to 98 percent for the small simple beef slaughter plant.

C. Production Effects

BPT guidelines are not expected to significantly effect red meat production volume. The impact of BAT water pollution control requirements on production of meat and processed meat products will occur principally through the closure of small plants where volume of production is such that the incremental costs required to install additional water pollution control systems make the continued operation of these plants uneconomic. However, such plants account for a small part of total industry production.

1. Production Curtailment

No significant long run curtailment in total production resulting from the imposition of increased water pollution control requirements is expected. Although aggregate volume data by plant size are not available, value of shipments in relation to employment in 1967 is available and will provide an indication of the relative volumes of different sizes of plants.

Table VI-6. Estimated cash flow on average invested capital for model meat packing plants, alternative effluent treatment levels, assuming no price change

	Primary	BPT	BAT
	(%)	(%)	(%)
Simple beef slaughter			
Small	11.0	9.9	0.2
Medium	14.4	13.8	11.4
Complex beef slaughter			
Medium	14.5	13.7	10.0
Large	15.1	14.5	11.7
Simple beef-hog slaughter			
Small	13.6	12.7	5.5
Medium	14.8	14.2	11.2
Complex beef-hog slaughter			
Medium	15.0	14.2	10.5
Large	16.7	16.1	13.1
Low-process packinghouse			
Small	14.2	13.6	10.7
Medium	17.2	16.8	15.3
Large	19.9	19.6	18.1

Table VI-7. Estimated cash flow for model meat packing plants, alternative effluent treatment levels, assuming no price change

	Primary	BPT	BAT
	($000)	($000)	($000)
Simple beef slaughter			
Small	48	44	1
Medium	323	315	275
Complex beef slaughter			
Medium	331	319	245
Large	617	601	508
Simple beef-hog slaughter			
Small	67	64	25
Medium	332	324	272
Complex beef-hog slaughter			
Medium	342	330	256
Large	658	642	549
Low-process packinghouse			
Small	163	159	132
Medium	886	874	814
Large	1,826	1,812	1,719

Meat Packing - 1967

Number of employees	Number of plants	Value of shipments Millions of $	% of total
Less than 20	1742	517.4	3.3
20 - 49	420	1235.8	7.9
50 - 99	221	1726.4	11.1
100 - 249	169	2827.9	18.2
250 - 499	84	3388.9	21.7
500 - 999	30	1835.8	11.8
1000 - 2499	23	2246.5	14.4
2500 and over	8	1797.4	11.6
Total	2697	15576.1	100.0

In terms of the large, medium and small classifications used in this study, large plants would employ 250 or more employees, medium plants 50 to 249 and small plants 49 or fewer. Based on these employment levels, the volume relationships would be as follows:

Small plants	11.2 percent of total shipments
Medium plants	29.3 percent of total shipments
Large plants	59.5 percent of total shipments

Since the livestock slaughter and meat packing industry commonly operates at less than 100 percent of capacity (85 percent utilization was assumed in this report), and since plant closures would occur mainly among small plants which account for only slightly over 10 percent of total production, it is anticipated that the remaining plants could easily absorb the volume which would be lost through plant closures. In reality, the principal determinant of the volume of livestock slaughtered is the number of slaughter livestock produced and marketed off farms. To the extent that it becomes necessary, remaining plants could extend their work week and start double-shift operations to pick up the volume of plants which close.[1/]

2. Plant Closures

Plant closures in the meat packing and slaughter industry would be greatest among small plants with a much greater impact on slaughter only plants than would be the case for meat packinghouses.

1/ It is recognized that in some plants cooler space is not adequate to allow double shifts for prolonged periods. However, many plants have enough cooler space for double shifts and most have enough for at least one and one-half shifts.

It becomes difficult to isolate those instances where closures would result from the imposition of effluent controls from those instances where plants would have closed due to other reasons (obsolescence, poor management, etc.). However, in the analysis of projected plant closures, an allowance was made for historical trends in plant numbers in this industry. A further complicating factor is that, in spite of declining plant numbers, total volume of slaughter in the industry has risen rapidly, especially in recent years. This increasing total demand for meat and meat products has been the result of two principal factors, (1) increasing population and (2) increasing per capita consumption. Increasing per capita consumption has been largely influenced by gains in disposable personal incomes since the demand for beef is income-elastic.

DPRA estimated base numbers of plants in 1977 and 1983 on the assumption all existing (1973) plants have controls in place equivalent to baseline conditions. The DPRA base number of plants, shown for 1977 and 1983 in Tables VI-10, VI-12, and VI-14 reflect changes in plant numbers related to non-effluent control factors. For example, as substantial numbers of small plants close and as the total demand for red meats is expected to continue to increase, it is anticipated that new construction in the industry will be primarily directed toward large plants, but some medium-sized plants will continue to be built.

a. NSPS guidelines

Table VI-9 shows the estimated percentage of plants operating in 1973 with profits sufficient to warrant replacement investment under NSPS treatment levels, assuming no compensating price increase to offset effluent control costs. Three effluent control conditions are specified -- Baseline, pre-1983 and post-1983.

Baseline impact - If only baseline effluent controls are specified, and if all plants are valued at replacement cost, the imposition of these controls would make unprofitable nearly all small slaughter plants and meat packinghouses, approximately 75-80 percent of the medium-sized plants, 75 percent of the large beef slaughter plants, over half of the large combined slaughter plants and over 25 percent of the large packinghouses.

Table VI-9. Percentage of plants operating in 1973 with profits sufficient to warrant replacement investment under NSPS treatment levels, assuming no price change

Type and size of plant	Baseline	Pre-1983*	Post-1983*
	%	%	%
Simple beef slaughter			
Small	< 1	0	0
Medium	10	6	0
Complex beef slaughter			
Medium	18	4	0
Large	26	19	1
Simple beef-hog slaughter			
Small	3	1	0
Medium	13	9	0
Complex beef-hog slaughter			
Medium	12	7	0
Large	46	38	7
Low-process packinghouse			
Small	2	1	0
Medium	31	28	12
Large	72	71	57

* NSPS guideline costs are assumed equal to BPT until 1983 at which time they will equal BAT costs.

Pre-1983 impact - With all values at replacement cost, pre-1983 guidelines would result in additional plants becoming unprofitable, particularly in the medium sized plants where an additional 4 percent (about 12 plants) would become unprofitable. The impact would be less severe on the large plant category.

Post-1983 impact - The imposition of BAT equivalent controls, which add substantial investment and operating costs, would have a severe impact on profits if all plants were valued at replacement cost. All small plants (both slaughterhouses and meat packinghouses) would become unprofitable, as would all medium sized slaughter plants and 88 percent of medium packinghouses. Less than 10 percent of the large slaughter plants would remain profitable, but 57 percent of the large packinghouses would continue profitable.

In conclusion, NSPS guidelines are expected to have very little, if any, impact on new packinghouse construction rates. Pre-1983 impacts on slaughter plants would be a larger relative advantage for large plants. Post-1983 impacts would retard plant construction in non-sewered areas but, not drastically. However, unless profit margins widen, it would be nearly impossible to justify construction of new slaughterhouses in non-sewered areas after 1982.

b. Plant closures, BPT (1977)

Table VI-10 shows projected BPT plant closures. Closures shown are only those which would result from the imposition of BPT requirements and thus are in effect incremental above Baseline control levels. The 1977 base numbers are the number of plants projected to exist in 1977 without the imposition of BPT controls. As seen from Table VI-10, the imposition of BPT is expected to result in one small slaughter plant closure. Although BPT costs are appreciable and would reduce profits, they are not generally great enough to result in plant shutdowns.

Table VI-10. Projected BPT (1977) effluent control-associated plant closures, meat packing and slaughter plants

Type and size of plant	1977 Base[2/] numbers	Projected 1977 closures[2/] % of total	Number
Slaughter only plants[1/]			
Small	83	< 1	1
Medium	39	-	0
Large	17	-	0
Packinghouses[1/]			
Small	247	0	0
Medium	109	0	0
Large	48	0	0
Total	543	-	1

1/ 1973 - 80% of total number of plants are packinghouses. 1977 estimate is that 82.5% of total number of plants would be packinghouses.

2/ Base numbers include only those plants classified as direct dischargers and, hence, exclude those served by municipal sewers.

Table VI-11 shows the combined impact of BPT treatment costs and other factors in terms of expected changes in plant numbers 1973-1977. A pronounced shift from small to larger plant sizes results. For slaughter plants, small operations are reduced in number by 36 plants or 20 percent as compared to 1973. A loss of 12 medium-size plants (15 percent) is projected, but a gain of 8 large plants (36 percent) is projected. The gain in large plants results both from the construction of new plants and from the expansion of existing medium sized plants into the large category. The loss in medium plants results both from plant closures and from expansion of existing plants into the large category.

d. Plant closures, BAT

Table VI-12 shows projected BAT plant closures. Closures shown are those above those resulting from the imposition of BPT controls and are thus incremental in nature. The 1983 base numbers shown in Table VI-12 reflect closures (since 1973) due to imposition of BPT controls as well as closures due to factors not associated with effluent controls. For the large category the increase in numbers reflects both new plants and expansion of plants formerly classified in the "medium" size category. As seen from Table VI-12, the imposition of BAT controls, without compensating price increases, results in the closure of 71 percent of the small slaughter plants, 12 percent of the medium slaughter plants and 7 percent of the small packing plants. Large plants are not severely impacted. However, BAT controls would result in the expected closure of 67 plants. BAT control systems involve more complex and technically sophisticated waste treatment equipment with the results that both investments and annual costs are substantial. For small plants, investment per plant would be near $250,000 (Table V-7, above) with annual costs of nearly $100,000. Medium plants would require BAT investments of over $500,000 with annual costs of over $250,000. Large plant investments would be near $750,000 and annual costs over $300,000.

Table VI-13 shows the combined impact of BAT control costs, BPT costs and other factors as they influence changes in plant numbers 1973-1983. BAT controls, with no compensating price increases would close 45 small slaughter plants, 4 medium slaughter plants and 1 large slaughter plant, 16 small packinghouses and 1 medium packinghouse. The cumulative effect of effluent controls plus the influence of other factors not associated with effluent controls would result in the closure of 65 percent (115 plants) of the number of small slaughter plants which existed in 1973 and 36 percent

Table VI-11. Projected changes in slaughterhouse and meat packing plant numbers, 1973-1977 due to both effluent controls and other factors[1]

Type and size of plant	Estimated plant nos. 1973	Change in plant nos. due to non-effluent factors[2]: Number	Change in plant nos. due to non-effluent factors[2]: % of 1973	Change in plant nos. due to effluent controls: Number	Change in plant nos. due to effluent controls: % of 1973	Total change no. plants	Plants remaining, 1977: Number	Plants remaining, 1977: of 1973
Slaughter only								
Small	178	-34	-19	- 2[3]	-1	-36	142	80
Medium	80	-12	-15	0	0	-12	68	85
Large	22	+ 8	+36	0	0	+ 8	30	136
Meat packing								
Small	750	-55	- 7	0	0	-55	695	93
Medium	305	+ 2	+ 1	0	0	+ 2	307	101
Large	85	+50	+59	0	0	+50	135	159
Total	1, 420	-41	-	-	-	-43	1, 377	-

1/ Includes both sewered plants and direct dischargers.

2/ Anticipated change in plant numbers due to factors not related to effluent control such as obsolescence, poor management, new plant construction, etc.

3/ Assumes 1 sewered plant and 1 direct discharger will be closed due to incremental treatment costs.

Table VI-12. Projected BAT (1983) effluent control-associated plant closures, meat packing and slaughter plants

Type and size of plant	1983 Base numbers [2/]	Projected closures by 1983 [3/] % of total	Number
Slaughter only plants [1/]			
Small	63	71	45
Medium	32	12	4
Large and extra large	20	4	1
Packinghouses [1/]			
Small	227	7	16
Medium	110	1	1
Large and extra large	69	0	0
Total	521		67

1/ 1973 - 80% of total number of plants are packinghouses.
1983 estimate is 85% of total number of plants would be packinghouses.

2/ Includes only those plants classified as direct dischargers.

3/ Assumes plants have met BPT controls in 1977.

Table VI-13. Projected changes in slaughterhouse and meat packing plant numbers, 1973-1983 due to both effluent controls and other factors 1/

Type and size of plant	Estimated plant nos. 1973	Change in plant nos. due to non-effluent factors 2/		Change in plant nos. due to effluent controls		Total change no. plants	Plants remaining, 1983	
		Number	% of 1973	Number	% of 1973		Number	of 1973
Slaughter only								
Small	178	- 68	- 38	-47 3/	-26	-115	63	35
Medium	80	- 25	- 31	- 4	- 5	- 29	51	64
Large	22	+ 13	+ 59	- 1	- 5	+ 12	34	155
Meat packing								
Small	750	-110	- 15	-16	- 2	-126	624	83
Medium	305	+ 5	+ 2	- 1	0	+ 4	309	101
Large	85	+110	+129	0	0	-110	195	229
Total	1,420	- 75	-	-67	-	-144	1,276	-

1/ Includes both sewered plants and direct dishcargers.

2/ Anticipated change in plant numbers due to the imposition of factors not related to effluent control such as obsolescence, poor management, new plant construction, etc.

3/ Assumes 1 sewered and 1 direct discharger will be closed due to incremental treatment costs during the period, 1973-1977.

(29 plants) of the medium slaughter plants. However, a 55 percent increase (12 plants) is projected for large slaughter plants. Primarily small packinghouses would be shut down by 1983, but the number (126 plants) represents 17 percent of this industry category. Little change is projected for medium-sized packinghouses, but large packinghouses are expected to more than double in number by 1983.

e. Very small plant closures

It is estimated that there are approximately 4,600 very small slaughterhouses, meat packinghouses, custom butchers and locker plants which slaughter. These are plants which average less than 2 million pounds annual kill, which is equivalent to a kill rate of 7-8 1,040-pound steers per day for 250 days per year. Many of these plants will kill even smaller numbers of livestock. For example, it is estimated that there are 2,600 frozen food locker plants which slaughter for their customers and average approximately 500,000 pounds annual kill, less than 2 steer-equivalents per day. Many other small custom butchers would fall in this category.

It is estimated (by EPA) that 50 percent of these very small plants may be discharging into municipal sewers. The balance probably either have lagoon systems, septic tanks or discharge raw effluent.

There are no reliable data on costs of effluent treatment systems for these plants. EPA estimates an average investment cost of $10,000 would be required for effluent treatment for locker plants. Estimated annual costs would total $2,000, consisting of capital cost $1,000, depreciation 400 and other direct operating costs $600.

A large proportion of these very small slaughterers kill livestock as a service or as an adjunct to another business. Locker plants, retail butchers, small sausage processors, custom slaughterers, institutions (educational and others), specialized food processors and other similar firms are included in this group together with very small slaughterhouses. No information exists regarding the relative numbers of such firms, except the estimate of locker plants.

In most instances, those firms where slaughter is conducted as a service (e.g. locker plants) or where slaughter is a necessary, but minor part, of their overall operations, would survive. This could account for as many as 3,600 units. Educational and other institutions (prisons, etc.) would survive as their costs are supported by public funding. This could add another 200 plants. Of the remaining 800 plants, 400 are estimated to be on municipal sewers, and due to the low volume of effluent generated and in view of the possibility of further effluent reductions by improved in-plant operating procedures, it is expected that these plants would also survive.

Of the remaining 400 very small slaughterers, the low kill volume (2 to 3 head per day as an average), together with killing and cutting practices of such small killers would result in low volumes of effluent. Most of these small killers have established sources of disposal of offal and blood (often sold to renderers) and the volume of liquid wastes generated could, in most cases, be handled by ordinary septic tank systems. It is believed that most of these small plants have adequate septic tank systems. Although some closures would undoubtedly result where plants are discharging raw sewage into streams, it is expected that only a small number of plants would be affected and the impact on production and employment would be insignificant.

D. Employment Effects

1. Employment Trends

Employment in the meat packing industry has declined steadily during the past 20 years in spite of a steady uptrend in the volume of meat produced by the industry.

Year	Employment in meat packing[1]	
	Total employees (000)	Production workers (000)
1954	220.2	167.8
1958	201.0	150.9
1963	181.0	138.8
1967	170.5	130.8

1/ Source: U.S. Department of Commerce, Census of Manufactures.

Although declining employment and increasing output would mean that production per man-hour has increased, it must be recognized that part of this increase in labor productivity is the result of automation and other technological improvements in plant and equipment which increase the output per man-hour.

A relatively large proportion (75 percent) of the total employees of meat packing and meat processing industries are production workers.

Table VI-14 shows employment by size of firm. In the meat packing industry a high proportion of the firms (65 percent in 1967) employ fewer than 20 employees, but account for only a small percent (4.5 percent in 1967) of the total industry employment. At the other end of the scale, 8 large firms (0.3 percent) employed 15.3 percent of the industry total in 1967.

2. Wages

Wages in the meat packing industry are relatively high. In terms of total payrolls, average annual wages in 1972 ranged from about $6,700 in small plants to over $10,000 in large plants. The distribution of wages in 1967 was as follows:

No. employees per plant	Average annual wage 1967 1/	Average annual wage Estimated 1972
1-4	$5,353	$6,700
5-9	5,500	6,900
10-19	5,366	6,700
20-49	6,060	7,600
50-99	6,450	8,100
100-249	6,971	8,700
250-499	7,537	9,400
500-999	7,701	9,600•
1,000-2,499	8,044	10,100
2,500+	8,321	10,400

1/ 1967 wages inflated by 1972 CPI.

2/ Source: U.S. Department of Commerce, Census of Manufacturers.

3. Unemployment Associated with Plant Closures

As indicated in section C, the following plant closures might be anticipated as a result of the imposition of water pollution controls on the meat industry.

Table VI-14. Employment in the meat industry, employees per firm, by size group, 1958, 1963, 1967[1/]

	Meat Packing					
	1967		1963		1958	
Number of employees	No. plants	Em-ployees	No. plants	Em-ployees	No. plants	Em-ployees
		(000)		(000)		(000)
Less than 20	1,742	7.6	2,016	9.9	1,824	10.0
20-99	641	28.6	677	29.2	668	29.0
100-499	253	54.3	232	49.8	231	51.5
500-999	30	22.1	34	24.7	38	26.1
1,000-2,499	23	31.7	24	36.5	30	46.5
2,500 or more	8	26.1	9	31.1	10	37.7
Total	2,697	170.5	2,992	180.9	2,801	200.8

1/ Source: U.S. Department of Commerce, Census of Manufacturers.

Type & size of plant	Number Closed BPT No price increase	BAT No price increase
Meat packinghouses		
Small	0	16
Medium	0	1
Slaughter plants		
Small	1	45
Medium	0	4
Large	0	1

Unemployment and payrolls lost as a result of these plant closures was estimated to be as shown in Tables VI-15 and VI-16. In summary, these losses were as follows:

Level of Control	Jobs Lost	Payroll Lost ($000)
BPT, no price increase	25	$ 130
BAT, no price increase	2,765	21,890

4. Possibility of Reemployment in New Plants Being Built

There would be little probability that new plants would be built in the same area to replace small or obsolete plants which were forced to close because of their inability to add necessary equipment to comply with water pollution control requirements. Small meat packing, slaughter or processing plants face substantial disadvantages due to economies of scale in slaughtering, processing and water pollution control operations. As a result, it is doubtful that these small plants would be replaced since medium or large plants are widely distributed geographically and could absorb the added volume represented by these small plants. Obsolete plants are most likely to persist in areas where the meat packing and processing industries are declining and as a result there would be little inducement to replace plants in these areas.

Table VI-15. Estimated unemployment and wage losses resulting from imposition of BPT effluent controls on the meat industry, no compensating price increases

Type and size of plant	Est. No. closures 1/	Est. employees per plant		Estimated unemployment			Est. annual salary or wage		Estimated wage loss		
		Sup. & sales	Prod'n.	Sup. & sales	Prod'n.	Total	Sup. & sales	Prod'n.	Sup. & sales (000)	Prod'n. (000)	Total (000)
Slaughter plant, small medium	1	5	20	5	20	25	10,000	6,000	$10	$120	$130
Total	1	-	-	5	20	25	-	-	$10	$120	$130

1/ Assumes plants have already met Baseline effluent control requirements.

Table VI-16. Estimated unemployment and wage losses resulting from imposition of BAT effluent controls on the meat industry, no compensating price increases

Type and size of plant	Est. No. closures 1/	Est. employees per plant: Sup. & sales	Est. employees per plant: Prod'n.	Estimated unemployment: Sup. & sales	Estimated unemployment: Prod'n.	Estimated unemployment: Total	Est. annual salary or wage: Sup. & sales	Est. annual salary or wage: Prod'n.	Estimated wage loss: Sup. & sales (000)	Estimated wage loss: Prod'n. (000)	Estimated wage loss: Total (000)
Meat packinghouse,											
small	16	10	40	160	640	800	12,500	7,000	$2,000	$4,480	$6,480
medium	1	40	100	40	100	140	14,000	7,500	560	750	1,310
Slaughter plant,											
small	45	5	20	225	900	1,125	10,000	6,000	2,250	5,400	7,650
medium	4	25	75	100	300	400	14,000	7,500	1,400	2,250	3,650
large	1	50	250	50	250	300	16,000	8,000	800	2,000	2,800
Total	67	-	-	575	2,190	2,765	-	-	$7,010	$14,800	$21,890

1/ Assumes plants have already met Baseline effluent control requirements.

5. Absorption of Laid-off Employees by Other Plants

Little opportunity would exist for absorption of laid-off employees by other plants in the same area. Although the meat industry is geographically dispersed, total employment in the meat industry has been declining during the past ten years as larger, more-highly-automated plants have been built which require fewer employees per thousand pounds of live-weight killed or products processed. In addition, many plants operate only on a single-shift basis at less than 100 percent of capacity. Since the small plants represent, in aggregate, only slightly over 10 percent of the total volume of livestock killed or products processed, the volume represented by these plants could be absorbed by remaining plants without taking on additional employees.

6. Unemployment Effects on Livestock Feeders

Only minimal unemployment effects on local livestock feeders would be likely. Feeders have alternative markets to which they can sell their livestock. Feeders might be faced with higher transportation costs to move their livestock to alternate markets, but since the market for livestock and meats is spatially balanced, the transportation differential would not be great. Feeders would normally continue feeding and no unemployment should result in the livestock feeding industry as a result of the closure of small packinghouses or slaughter plants.

E. Community Effects

A high proportion of meat packinghouses and slaughterhouses are located in relatively small communities where their closure would have a noticeable impact on the economy of the community and surrounding area. Table VI-17 shows the distribution of Federally-inspected slaughtering establishments by size of city in which located. For the United States, the distribution was as follows:

Size of City (population)	Number of Plants
Over 500,000	114
100,000 - 499,999	138
50,000 - 99,999	61
25,000 - 49,999	62
10,000 - 24,999	133
Under 10,000	431
Total	939

Table VI-17. Meat packing and slaughtering plants, number of federally-inspected plants classified by size of city in which plants are located, August, 1972

State	Plants in cities having a population of:					
	Over 500,000	100,000-499,999	50,000-99,999	25,000-49,999	10,000-24,999	Under 10,000
Alabama	-	2	-	1	1	2
Arizona	4	2				
Arkansas		4	1	1	2	1
California	16	4	7	1	13	17
Colorado	9	3	2	4	3	4
Del.-Md.-D.C.	-	5	-	-	1	4
Florida	-	1	-	-	3	3
Georgia	-	-	2	-	3	3
Hawaii	-	1	-	-	-	-
Idaho	-	-	1	1	3	3
Illinois	9	3	2	5	5	15
Indiana	2	1	1	2	2	5
Iowa	-	2	5	5	2	24
Kansas	4	5	-	2	8	6
Kentucky	-	10	3	2	2	23
Louisiana	1	1	1	1	1	4
Michigan	8	1	-	2	2	4
Minnesota	7	-	-	3	3	48
Mississippi	-	-	1	-	2	4
Missouri	11	2	3	1	2	5
Montana	-	-	4	1	5	20
Nebraska		19	-	1	8	62
Nevada	-	-	1	-	-	1
New England	-	1	2	2	4	9
New Jersey	-	5	-	-	1	6
New Mexico	-	2	-	3	2	8
New York	1	14	3	2	1	18
N. Carolina	-	1	-	1	4	7
N. Dakota	-	-	2	-	2	33
Ohio	6	13	1	5	4	9
Oklahoma	-	3	-	3	3	2
Oregon		5	1	1	2	6
Pennsylvania	7	2	3	1	4	11
S. Carolina	-	2	-	-	3	1
S. Dakota	-	-	2	1	5	-
Tennessee	4	5	-	1	2	2
Texas	16	12	6	4	13	22
Utah	-	2	2	-	-	5
Virginia	-	1	1	2	3	17
Washington	1	3	1	2	5	10
W. Virginia	-	-	-	-	-	1
Wisconsin	8	1	3	1	2	6
Wyoming	-	-	-	-	1	-
Total	114	138	61	62	133	431

From this distribution, it is seen that 60 percent of all Federally-inspected slaughtering establishments were located in cities of less than 25,000 population. If over 4,600 very small slaughter plants, which are not Federally-inspected, were added to this tabulation, the proportion of slaughter plants in small communities would be much higher, probably greater than 75 percent.

The closure of a small plant could result in a reduction in payrolls of over $400,000 which would be approximately equivalent to 0.65 percent of the total payroll of a city of 25,000 (based on 8,000 employed workers earning $8,000 each). Assuming a multiplier of 3.5, the loss of a small meat plant could reduce the economic base of the community by as much as $1,400,000. A medium-size plant would carry an impact of from $3,000,000 to $5,000,000.

For a city of 8,000 the loss of a small plant would reduce city payrolls by 5 percent with a corresponding reduction in the economic base of the community. In addition to the loss in payrolls, the direct loss in purchases of utilities, transportation services, office supplies and other items by the plant would be felt throughout the community.

Other suppliers, i.e. spice companies, container manufacturers, equipment manufacturers, etc., are usually located in major metropolitan areas and in most instances would not be located in the communities where small plant closures would be anticipated.

Other community impacts would be felt in the loss in taxes which would result from the closure of the plant. In many localities, especially in recent years, packinghouses have been financed thru use of municipal revenue bonds and in such instances, closure of a plant results in added burdens for the city budget.

Although livestock feeders in the area served by the packinghouse and the community would be able to find alternative markets for their livestock, the loss of a strong local livestock market forces these producers to ship to more distant markets, incurring a greater transportation cost and resulting in lower net returns at the farm level. The reduction is farm income would also be felt throughout the community.

It is impossible to determine precisely the number and location of the communities where meat slaughterhouse or packinghouse plant closures would occur. However, as shown earlier in this section, a high proportion of these plants are in relatively small communities. Also, it is known that over 90 percent of firms in the meat industry are single-plant firms and approximately 85 percent of the plants are owned by single-plant firms. In addition, virtually all of the small plants would be owned by single-plant firms. Finally, very few small communities would have more than a single meat plant. As a result, it would follow that the number of communities impacted by plant closures would be close (within 10 percent) to the number of plants closed.

Given this situation, the number of communities impacted by commercial plant closures would be approximately as follows:

Level I, no price increase	-	1	communities	impacted
Level II, no price increase	-	67	"	"

F. Balance of Payments Effects

The United States is not a major exporter of meats, but on the other hand is importing increasingly large amounts of meats, mainly beef, mainly from Australia and New Zealand.

Meat Imports

Imports of all red meats for the period 1955 through 1971 are shown in Figure VI-1 and Table VI-18. Quantities imported rose from 258 million pounds in 1956 to 2,387 million in 1970, dropped off slightly in 1971, but rose to a record of 2,653 million pounds in 1972.

Of the total quantity imported in 1972, 2,653 million pounds, beef and veal accounted for 1,996 million (75.2%), pork 508 million pounds (19.2%) and lamb, mutton and goat 149 million pounds (5.6%).

The total quantity of red meats net imports in 1972 was equivalent to 7.2 percent of U. S. production. For beef, imports amounted to 8.7 percent of U. S. production, for pork 3.7 percent and for lamb and mutton, 27.4 percent. However, for specific classes of meat, e.g., boned, frozen lean beef, imports represent a much more important part of total supplies.

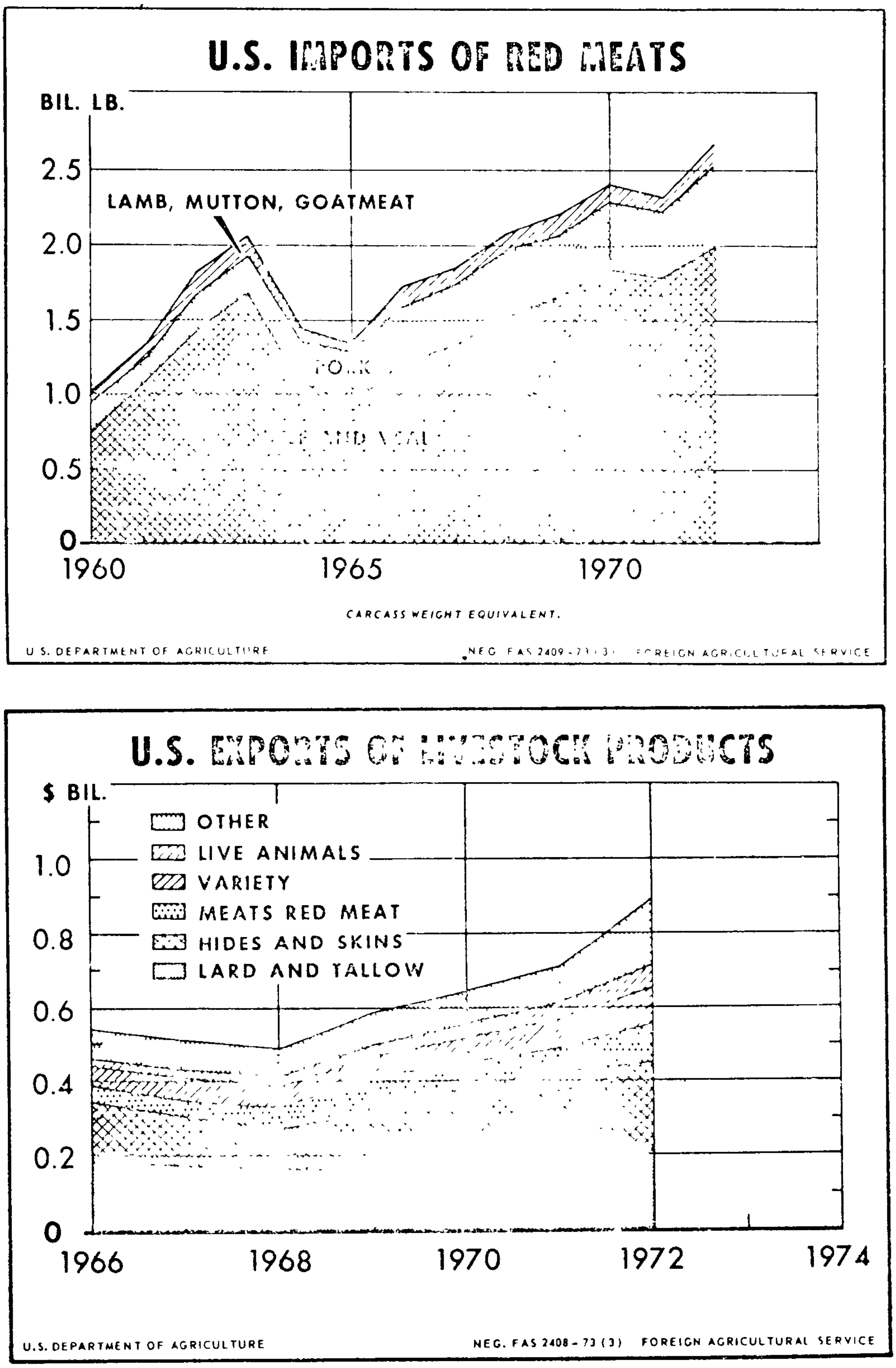


Figure VI-1. U. S. imports of red meats and exports of livestock products, 1960-1972

Table VI-18. U. S. meat imports, by product, 1960-1972[1/]

Product	1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
Beef													
Boneless fresh or frozen	1,714.5	1,447.4	1,484.2	1,348.9	1,224.7	1,116.0	986.7	734.3	919.2	1,362.8	1,182.9	764.8	556.8
Fresh or frozen	12.3	22.1	24.3	19.6	26.8	11.7	20.7	29.3	17.2	19.9	18.8	25.1	14.7
Canned or cured	233.4	264.2	283.7	246.3	248.2	185.8	174.8	159.4	131.3	268.4	212.6	230.8	188.7
Total	1,960.2	1,733.7	1,792.2	1,614.8	1,499.7	1,313.5	1,182.2	923.0	1,067.7	1,651.1	1,414.3	1,020.7	760.2
Veal													
Fresh or frozen	36.1	21.8	23.5	25.7	18.3	14.2	22.0	18.8	17.5	26.4	25.5	16.5	15.3
Pork													
Fresh or frozen	64.4	62.3	55.5	42.9	48.4	47.4	42.0	47.9	39.2	37.0	40.5	36.6	38.4
Hams & shoulders, canned	403.6	357.4	339.7	314.7	306.5	284.6	267.6	236.7	189.7	165.2	154.9	135.6	133.3
Other	40.2	38.9	53.2	51.2	61.2	60.5	71.7	48.4	38.5	22.8	20.4	15.0	13.9
Total	508.2	458.6	448.4	408.8	416.1	392.5	381.3	333.0	267.4	225.0	215.8	187.2	185.6
Lamb	37.3	38.2	43.5	43.9	22.9	12.3	14.9	12.5	10.4	18.9	13.2	10.9	12.4
Mutton & Goat	111.2	64.6	79.0	108.4	124.0	108.6	121.1	60.0	68.6	125.8	130.0	89.8	74.6
Total red meat	2,653.0	2,316.9	2,386.6	2,201.6	2,081.0	1,841.1	1,721.5	1,347.3	1,431.6	2,047.2	1,798.8	1,325.1	1,048.2

[1/] Sources: Livestock and Meat Situation, ERS, USDA, various issues.

Imports of beef have nearly tripled since 1960 (Table VI-18), with virtually all of the increase being imports of boneless beef for use in hamburger and other fabricated beef products. Veal imports have remained relatively stable. Pork imports have increased 175 percent with the bulk of the increase represented by imports of canned hams and shoulders. Imports of lamb were relatively constant until 1967, but have tripled since that time. Imports of mutton and goat declined through 1971, but rose sharply in 1972.

In 1972 Australia and New Zealand together supplied 52.0 percent of total U. S. meat imports, mainly beef, lamb and mutton. Denmark and the Netherlands supplied 12.5 percent, mainly hams and bacon, 6.4 percent came from Canada, 4.7 percent from Argentina and 4.3 percent from Mexico. Other important sources include Poland, Ireland and Brazil (Table VI-19).

Meat Exports

U. S. exports of meats are relatively small, 168.8 million pounds in 1972 and a substantial part of this total is meat by-products. Total exports equal five-tenths of one percent of U. S. production and are equal to only 4.8 percent of meat imports.

Exports go primarily to Canada and the Caribbean although Japan has become an increasingly important market in recent years (Table VI-20). In 1972 Canada took 41.9 percent of total U. S. meat exports, the Bahamas and Jamaica 9.5 percent, Japan 28.9 percent and the remaining 19.7 percent to other countries.

In December, 1972 meat-import quotas were suspended for 1973, extending an action taken in June 1972 to help check rising food costs.

It was expected that the strong economic expansion expected to continue during 1973 would lift demand for meat, putting "upward pressure" on prices. Suspension of the quotas was designed to moderate those inflationary pressures by encouraging increased imports of meat into the U.S.

PL 88-482 thus provides a barrier to substantial increases in the imports of red meats and would tend to dampen a tendency toward increased meat imports which might result if the wholesale price of meats in the U. S. were forced upward by increased costs associated with water pollution control requirements.

Table VI-19. U.S. meat imports, by country of origin, 1950 and 1960 and 1962-1972, million pounds product [1/]

Country of origin	Year 1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
Australia	747.9	563.8	596.2	565.2	506.4	482.5	467.9	337.7	411.5	582.8	507.6	278.5	183.2
New Zealand	286.7	254.2	263.8	247.1	203.8	180.3	156.1	115.0	176.9	250.6	224.8	165.2	139.9
Canada	127.5	149.6	144.4	94.6	102.2	81.7	105.0	125.9	80.1	63.8	66.7	77.1	66.3
Argentina	94.2	88.4	141.1	130.1	132.6	108.6	80.5	54.8	54.4	87.4	56.0	65.2	52.7
Denmark	172.1	137.3	130.4	108.8	112.1	102.4	117.0	85.4	66.5	77.1	71.5	52.7	45.2
Netherlands	75.7	82.6	86.7	85.6	82.2	74.6	65.1	46.3	38.2	43.0	43.5	42.1	42.1
Mexico	85.9	79.1	78.6	66.5	65.6	47.8	57.1	46.3	48.9	73.0	59.3	53.5	39.1
Poland	66.7	54.9	56.0	53.6	55.2	57.2	51.7	53.0	44.0	41.1	40.2	34.8	35.1
Ireland	31.3	64.1	69.1	66.2	56.9	80.8	40.0	10.0	20.3	74.2	72.9	64.6	53.0
Brazil	48.0	63.1	28.8	34.3	31.7	9.6	18.3	24.7	10.4	10.9	17.2	16.3	9.0
All others	253.9	208.5	196.1	178.3	166.4	127.0	108.3	106.9	104.5	110.8	89.8	68.7	
Total	1,989.9	1,745.6	1,791.2	1,639.1	1,544.6	1,352.5	1,267.0	1,006.0	1,055.7	1,414.7	1,249.5	918.7	733.6

1/ Sources: Livestock and Meat Situation, ERS, USDA and Agricultural Statistics, USDA, various issues.

Table VI-20. U.S. meat exports, by country of destination, 1950 and 1960 and 1962-1972, million pounds product[1/]

Country of destination	Year 1972	1971	1970	1969	1968	1967	1966	1965	1965	1963	1962	1961	1960
Canada	70.7	42.6	38.9	78.1	50.9	47.8	44.2	39.7	69.8	100.4	51.7	56.2	37.2
Japan	48.7	28.3	17.8	58.6	26.1	1.4	.6	.8	8.6	15.8	.1	.8	3.5
Bahamas	12.2	12.5	12.9	14.5	13.7	11.6	7.6	6.8	6.8	5.1	4.0	4.1	4.3
Jamaica	3.8	4.2	3.7	3.7	5.0	5.0	4.4	5.0	6.6	5.8	4.9	4.6	4.1
All others	33.4	37.4	34.4	35.1	35.4	34.2	39.8	10.7	107.3	44.0	37.1	39.9	
Total	168.8	125.0	107.7	190.0	131.1	100.0	96.6	108.4	199.1	171.1	97.8	105.6	107.6

1/ Sources: Livestock and Meat Situation, ERS, USDA and Agricultural Statistics, USDA, various issues.

In view of the role which PL 88-482 would have in controlling volume of imports, the major impact which increased costs and prices would have on balance of payments would be through an increase in prices on the quota tonnage of beef imported.

A recent study, completed by the Economic Research Service, U. S. Department of Agriculture[1/] evaluated the effects of alternative beef import policies on U. S. beef and pork production. Under the assumption that PL 88-482 will remain in effect, this study projected (to 1980) a continued increase in prices of U. S. slaughter cattle and hogs, a continuing increase in per capita fed beef consumption, no change in per capita pork supplies and a gradual decrease in per capita non-fed beef supplies, part of which would be offset by increases in beef imports which are allowed to increase proportionate to increases in domestic beef production. Figure VI-2 shows the trends in selected, relevant variables.

This study further reinforces the conclusion that the impact of increased meat costs, resulting from the imposition of water pollution controls on the meat industry, would have a negligible effect on imports and exports of meat and balance of payments associated with the meat industry.

1/ Effects of Alternative Beef Import Policies on the Beef and Pork Sectors, Agr. Econ. Report No. 233, ERS, USDA, October 1972.

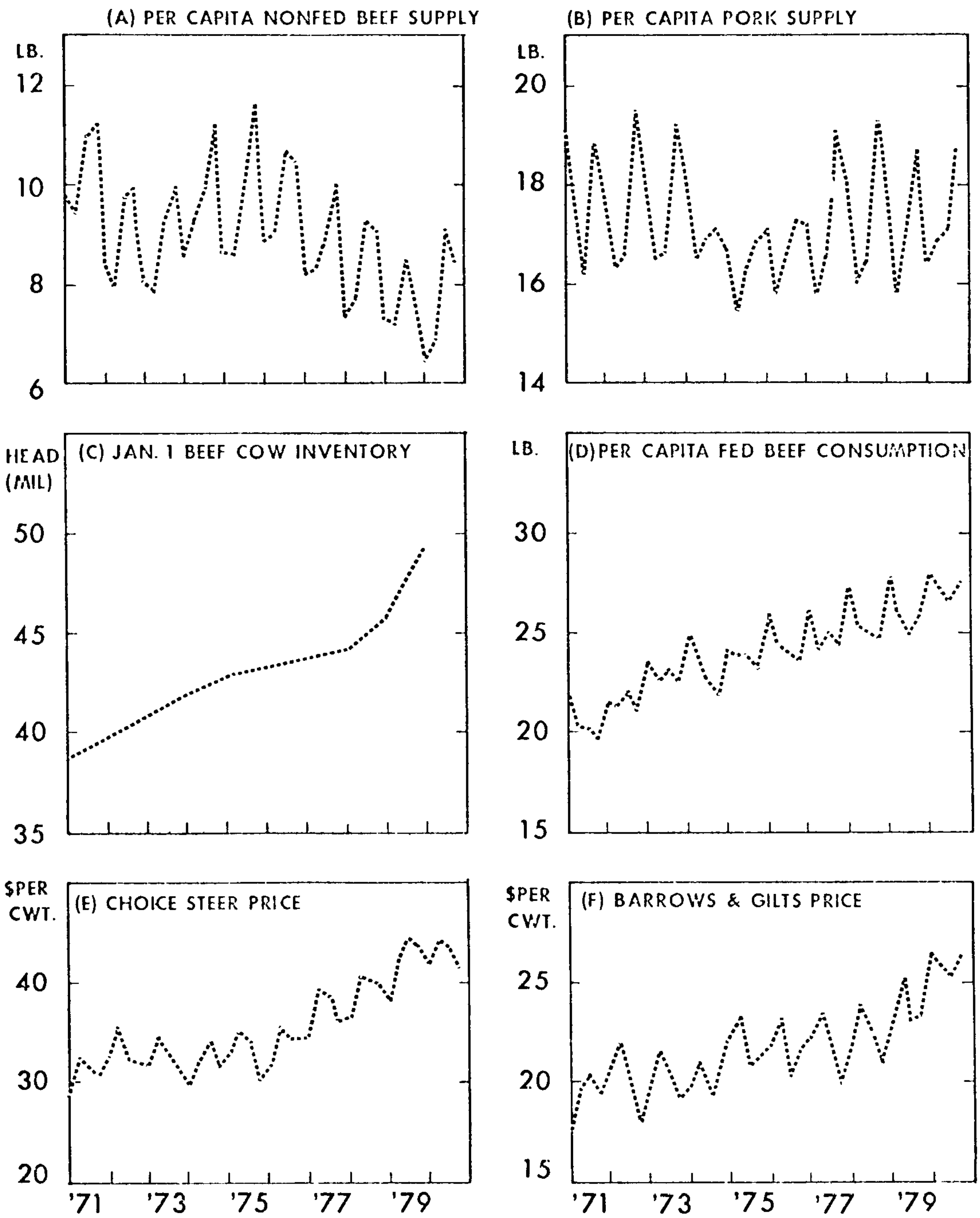


Figure VI-2. Projections of selected beef and pork variables, 1971-1980, assuming a continuation of regulation of beef imports under PL 88-482.

Source: Effects of Alternative Beef Import Policies on the Beef and Pork Sectors, ERS, USDA, Agricultural Economic Report No. 233, October, 1972.

VII. LIMITS OF THE ANALYSIS

A. General Accuracy

The livestock slaughtering and meat packing industry is complex in terms of the number, ownership and geographic distribution of firms as well as the sizes and types of plants.

Detailed data on size distribution by types of plants is not available.

Financial information concerned with investments, operating costs and returns was not available for individual plants or firms. As a result, the financial aspects of the impact analysis were, of necessity, based on synthesized costs and returns for "representative" types and sizes of model plants. These costs and returns were developed from a variety of sources including published research from universities and government agencies, previous studies done by the contractor, information obtained from operating firms in the meat industry, published financial performance data and discussions with meat processing consultants, meat plant architects and other knowledgeable individuals.

Published information from the Internal Revenue Service, such references as Standard and Poors, Dun and Bradstreet, and other sources of data on financial ratios and financial performance were used as checks on the reasonableness of results obtained in the financial analysis of representative plants.

Throughout the study, an effort was made to evaluate the data and other information used and to update these materials wherever possible. Checks were made with informed sources in both industry and government to help insure that data and information used were as reliable and as representative as possible. For example, construction costs were checked with established meat plant architects, working capital requirements were checked with the comptroller of a major meat packing firm, rendering equipment costs were based on a firm quote from an equipment supplier for a plant similar to one used in the analysis. The construction of published product prices was checked with the Market News Service, U.S.D.A. which constructs and publishes these price series. Efforts were made to use the latest available data.

Water pollution control costs were furnished by EPA, Effluent Guidelines Division and resulted from costs developed for EPA by North Star Research Institute. These costs were developed for four "typical" meat processing plants as described earlier in this report. It was necessary to adapt these costs to the types and sizes of model plants used in this analysis. This adaption process required the making of assumptions and adjustments related to these data which are critical to the impact analysis. In addition, it was necessary to make specific assumptions regarding the current status of effluent disposal and treatment in the meat packing industry. These assumptions are described in detail in the "Critical Assumptions" section of this report. The validity of these assumptions and of the effluent control costs which result introduce an additional element of uncertainty and possible inaccuracy.

However, given the accuracy of the pollution control costs to be acceptable, it is believed that the analysis represents a usefully accurate evaluation of the economic impact of the proposed effluent guidelines on the livestock slaughtering and meat packing industry.

B. Range of Error

Different data series and different sections of the analysis will have different possible ranges of error.

1. Errors in Data - Estimated data error ranges as an average for the industry are as follows:

		Error Range %
1.	Information regarding the organization and structure of the industry, number location and size of plants, and other information descriptive of industry segments	± 10
2.	Price information for products and raw materials	± 3
3.	Cost information for plant investments and operating costs	± 10

4. Financial information concerning the meat industry ± 10

5. Salvage values of plants and equipment ± 20

6. Effluent treatment costs[1/]
   a. Small plants ± 50
   b. Medium plants ± 25
   c. Large plants ± 10

2. Errors in Plant Closure Estimates - In Chapter VI, expected plant closure numbers were presented. Based on the best information available to the contractor, those numbers represent the most probable number of closures. Given the above described error ranges in the supportive data, it is very important to recognize that the closures presented in the impact chapter are subject to similar error ranges. Closure numbers under the best possible and worst possible conditions with respect to supportive data errors are described below. However, it is believed that the possibility of either of these extreme conditions prevailing is unlikely.

Best possible situation: Under the best possible conditions, errors in supportive data would be:

1. 10 Percent fewer plants would be direct dischargers
2. 10 Percent fewer plants would be small
3. 10 Percent fewer plants would be slaughter only
4. Profits would be 25 percent higher than those used in the analysis
5. Plant salvage values would be 20 percent lower than those used in the analysis
6. Estimated effluent treatment costs would be too high by:

Small plants	50%
Medium plants	25%
Large plants	10%

7. Capital availability would not be a determining factor
8. Cost of capital would be 5 percent rather than 6 percent

Under these best possible conditions, no plants would close under BPT guidelines and only 20 (all small) plants would be forced to close due to imposition of BAT guidelines.

1/ Error ranges for effluent treatment costs are the contractor's estimate. EPA did not provide error ranges.

Worst possible situation: Under the worst possible conditions, errors in the supportive data would be:

1. 10 Percent more plants would be direct dischargers
2. 10 Percent more plants would be small
3. 10 Percent more plants would be slaughter only
4. Profits would be 25 percent lower than those used in the analysis
5. Plant salvage values would be 20 percent higher than those used in the analysis
6. Effluent treatment costs would be too low by:

Small plants	50%
Medium plants	25%
Large plants	10%

7. Capital would not be available to finance effluent treatment investment costs unless net present value of future earnings less costs (including treatment costs) exceeds 10 percent of the plant salvage value (prior to installation of BPT and BAT treatment systems)
8. Cost of capital would be 7 percent instead of 6 percent

Under these worst possible conditions, we would feel 25 (all small) plants would be forced to close due to BPT guidelines and 360 plants due to BAT guidelines.

C. Critical Assumptions

The complex of types and sizes of slaughter and meat packing plants, processes involved and effluent control levels and systems proposed to meet these levels, all required the making of a series of assumptions required to keep the analysis withi manageable limits and to specify "representative" situations which would permit further development of industry-wide impacts. These assumptions fall into seven general areas:

1. Assumptions regarding industry structure
2. Assumptions concerning raw material and product prices
3. Assumptions concerning "representative" model plants
4. Assumptions concerning water pollution control costs
5. Assumptions concerning current status of effluent disposal systems in use by the industry
6. Assumptions concerning the salvage value of plants and equipment
7. Assumptions concerning "shutdown" decisions of slaughters and meat packers.

1. Industry structure - The meat industry is both large and complex in its organization. A critical factor affecting the analysis is the number and size of plants. Detailed data are not available on volume of slaughter by individual plants. However, a tabulation by state, by size class -- large, medium and small -- of Federally-inspected plants was made by the Statistical Reporting Service, USDA especially, for this project. In addition to the 1,364 plants under Federal meat inspection in 1973 there were approximately 4,627 plants operating under State inspection. It was assumed that all of these non-Federally inspected plants would fall into the small category, that is that these plants would kill less than 25 million pounds annually. It is believed that, with few exceptions, this assumption is correct. The distribution of Federally-inspected slaughter plants was based on 1971 data. However, since that time more rigid enforcement of inspection requirements has resulted in an increase in the number of Federally-inspected plants from 766 in 1971 to 1,364 in 1973. Since this increase was primarily due to a shift from State-inspected to Federally-inspected status, it was assumed that these new Federally-inspected plants would be in the "small" category.

2. Price assumptions - Prices for livestock, meat, meat products and by-products were based on published prices, mainly from the Market News Service, Agricultural Marketing Service, U.S.D.A. Live hog carcass values were estimated by DPRA by applying a commonly-used industry formula to live hog prices. For some specialized, processed products, not quoted by the USDA, prices published in the National Provisioner, a trade magazine, were used. The basis for the development of these prices, e.g. hide and offal values, was discussed with Market News Service representatives responsible for the development of these price series to determine the applicability of the prices to the types of plants and situations used in the analysis. As a result, it is believed that the price series used are generally applicable to the types of plants and products used in the analysis.

3. "Representative" model plants - No single plant is "representative" of the complex of types and sizes of plants which constitute the livestock slaughter and meat packing industry. DPRA classified plants as "slaughter only" (no processing) and as meat packinghouses (slaughter and processing). In addition, the slaughter only plants were classed as beef slaughter only and combined beef and pork slaughter. Three sizes of plants, large, medium and small, were specified since it was assumed that there were economies of scale in effluent treatment as well as slaughtering and meat packing operations. In addition to these type and size classifications, the Effluent Guidelines Division of EPA (through their contract with North Star Research Institute) classified slaughter plants as "simple" and

"complex" and meat packinghouses as "low-process" and "high-process" plants. The types and sizes of model plants used are shown in Figure VII-1. This classification results in a total of 18 "model" plants of which 11 were analyzed by DPRA. Those plants not analyzed, e.g. "large, simple slaughter" were excluded for the reason that few, if any, plants in this category were believed to exist.

It is recognized that this classification of plants does not approach the variety of types and sizes of plants which exist in this industry. In reality, each plant is individually engineered and equipped to meet the requirements of a particular site and location. In addition, the product mix will vary from plant to plant and from time to time within a given plant.

The need to classify plants into a manageable number of types and sizes constitutes a limiting, but necessary assumption. Based on previous studies completed by DPRA, it was known that the smaller plants would be impacted to a greater degree than would those in the medium and large size categories. The model "small" plant analyzed by DPRA was in the upper end (23 million pounds annual kill) of the "small" size category. The very small plants (under 2 million pounds annual kill) were excluded from this analysis of commercial plants since adequate pollution control costs were not available for these plants. However, the probable impact on these very small plants was discussed in the analytical section of the report.

4. Water pollution control costs - Data on water pollution control costs were supplied to DPRA by the Effluent Guidelines Division of EPA. Critical limitations regarding the applicability of these water pollution control costs include the following:

a. The segmentation of the industry into "simple" and "complex" slaughter plants and "low" and "high processing" meat packinghouses, according to effluent characteristics permits an adequate classification of the industry for the purpose of differentiating economic impacts of water pollution control costs.

b. Although EPA presented the costs of effluent control as "average total costs," discussions with EPA and North Star led to the conclusion that these costs were in reality "incremental" over a baseline situation which assumed that plants had in-place equipment to control settleable solids and grease and also had an anaerobic + aerobic lagoon system. Accordingly, DPRA developed a cost series which assumes all

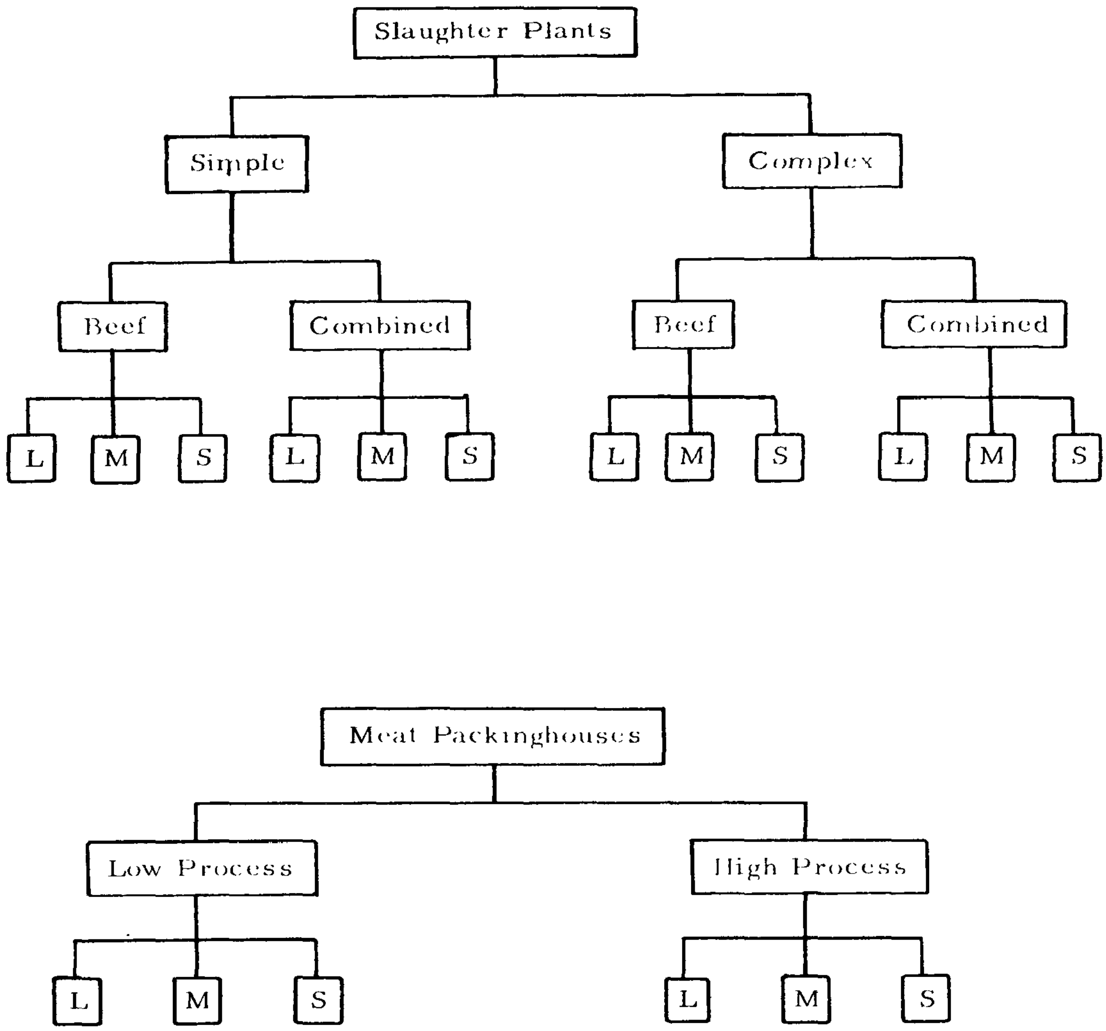


Figure VII-1. Types and sizes of "model" plants used in impact analysis.

plants currently have baseline treatment systems in place. These costs were applied to each of the types and sizes of plants specified in the DPRA report.

c. Wastewater treatment costs, as provided by EPA, were for one size plant, for each of the four plant categories specified in their report. It was necessary to develop basic wastewater flow-relationships for the Baseline and BPT and BAT controls. This required the use of background data to develop the relevant cost curves. Information from EPA and North Star indicated that the capacity-cost relationships would be the same regardless of the type of plant (slaughter-packinghouse) considered. Although data were available for only four plants, cost curves were developed and estimates of investment and annual costs were made for large, medium and small plants as defined in this report. The limited number of observations available does not permit an evaluation of the accuracy of these cost estimates--especially at the lower ranges of waste-flow value.

d. Lacking background information regarding effluent control technologies specifically included in the control cost estimates for each type of plant and control level, DPRA has used the effluent control costs supplied by EPA adjusting these costs insofar as possible to the types and sizes of plants analyzed and updating the costs to 1972 levels by applying appropriate cost index inflators.

5. Current status of municipal treatment in the industry - Only limited information is available concerning the current status of effluent control in the meat packing and slaughter industry. The DPRA report made the assumption that 85 percent of commercial-sized plants in the meat industry discharge into publicly-owned wastewater treatment systems and that 50 percent of the very small processors and frozen food locker plants which slaughter discharge into municipal systems.

6. Salvage values - Salvage values of buildings, equipment and land will vary greatly from one location to another and with the type and condition of structures and equipment.

In order to avoid problems which would be inherent in attempting to establish differential salvage values, a set of "standard" assumptions concerning salvage values was developed.

a. Land was salvaged at its 1972 value
b. Buildings and equipment were salvaged at a net amount equivalent to 10 percent of their 1972 replacement value
c. Net operating capital was recovered intact.

7. "Shutdown" decisions - The general purpose of the "shutdown" model is to examine profitability of the model plants before and after the imposition of effluent limitation guidelines, to determine the profitability of forced closures which would result and to calculate the price changes required to cover the added effluent control costs.

The model required assumptions relative to numerous factors.

These assumptions are described in detail in previous sections of this report. Assumptions used, while arbitrary, were made in accordance with estimates of conditions prevailing in the livestock slaughter and meat packing industries.

BIBLIOGRAPHIC DATA SHEET	1. Report No. EPA-230/1-73-014	2.	3. Recipient's Accession No.

4. Title and Subtitle
Economic Analysis of Proposed Effluent Guidelines - Meat Packing Industry

5. Report Date
September, 1973

6.

7. Author(s)
Raymond E. Seltzer, James K. Allwood

8. Performing Organization Rept. No. 119

9. Performing Organization Name and Address
Development Planning and Research Associates, Inc.
P. O. Box 727
Manhattan, Kansas 66502

10. Project/Task/Work Unit No.
Task Order No. 3

11. Contract/Grant No.
Contract No. 68-01-1533

12. Sponsoring Organization Name and Address
Environmental Protection Agency
Waterside Mall
4th and M Street, S. W.
Washington, D. C. 20460

13. Type of Report & Period Covered
Final Report

14.

15. Supplementary Notes

16. Abstracts

The economic impacts of proposed effluent guidelines on livestock slaughtering and meat packing (slaughter and processing) plants are assessed. The analysis includes description and statistical compilations regarding the number, location and characteristics of types of firms and plants; financial profiles, investments, operating costs and returns for industry segments analyzed; evaluation of product prices, pricing mechanisms and price relationships; description of analytical procedures employed; evaluation of costs of proposed effluent treatment technology; economic impacts resulting from imposition of effluent guidelines in terms of effects on prices, industry returns, volume of production, employment, community economies, and foreign trade. Limits of the analysis are stated.

(continued)

17. Key Words and Document Analysis. 17a. Descriptors

Pollution, water pollution, industrial wastes, meat packing, economics, economic analysis, discounted cash flow, demand, supply, prices, fixed costs, variable costs, community, production capacity, fixed investment

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group
05 Behavioral and social sciences, C-economics
06 Biological and medical sciences, H-food

18. Availability Statement
National Technical Information Service
Springfield, Virginia 22151

21. No. of Pages 138

16. Abstracts (Continued)

Imposition of BPT level controls (1977) would have a negligible impact on the industry if the current effluent control status (virtually all plants having primary and secondary treatment facilities in place) is as reported and if control costs are as stated by EPA. Compliance with BAT (1983) level controls could result in the closure of 65-70 commercial plants (10 percent of plants not on municipal sewers) under conditions assumed in the analysis, with a loss of 2,700-2,800 jobs, a reduction of $21-22 million in payrolls and corresponding impacts on affected communities. Production would not be reduced and there would be little impact on foreign trade. However, if assumptions regarding existing status of treatment, projected pollution control costs, and industry costs and returns are less favorable than those used in the analysis, the impact on the industry could be much more severe and would result in closure of a large percentage of plants not served by municipal treatment systems.