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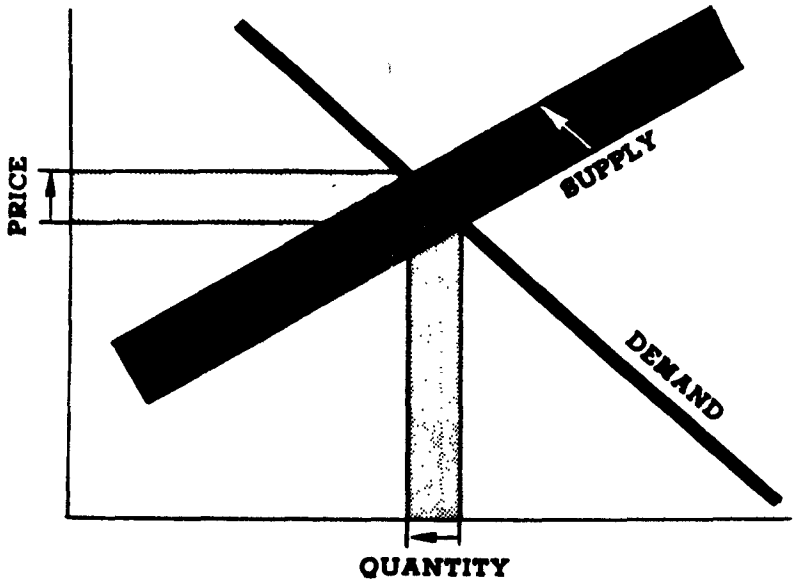
ECONOMIC ANALYSIS OF PROPOSED EFFLUENT GUIDELINES

THE POULTRY MEAT PROCESSING INDUSTRY



U.S. ENVIRONMENTAL PROTECTION AGENCY
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ANALYSIS OF THE ECONOMIC IMPACT OF PROPOSED EFFLUENT LIMITATION GUIDELINES FOR THE POULTRY MEAT PROCESSING INDUSTRY

Prepared for

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PREFACE

The attached document is a contractor's study prepared with the supervision and review of the Office of Planning and Evaluation of the U.S. Environmental Protection Agency (EPA). Its purpose is to provide a basis for evaluating the potential economic impact of effluent limitations guidelines and standards of performance established by EPA pursuant to section 304(b) and 306 of the Federal Water Pollution Control Act.

The study supplements an EPA technical Development Document issued in conjunction with the promulgation of guidelines and standards for point sources within this industry category. The Development Document surveys existing and potential waste treatment and control methods and technologies within this category and presents the investment and operating costs associated with various control technologies. This study supplements that analysis by estimating the broader economic effects (including product price increases, continued viability of affected plants, employment, industry growth and foreign trade) of the required application of certain of these control technologies.

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. 15 by Development Planning and Research Associates, Inc. Work was completed as of October, 1974.

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.

This report represents the conclusions of the contractor. It has been reviewed by the Office of Planning and Evaluation and approved for publication. Approval does not signify that the contents necessarily reflect the views of the Environmental Protection Agency. The study has been considered, together with the Development Document, information received in the form of public comments on the proposed regulation, and other materials in the establishment of final effluent limitations, guidelines and standards of performance.

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REFERENCES

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APPENDIX A - Cost of Effluent Treatment Data Provided by the Environmental Protection Agency

APPENDIX B - Calculations of Cash Flows Used in Discounted Cash Flow (DCF) Analysis.

ANALYSIS OF THE ECONOMIC IMPACT OF PROPOSED EFFLUENT LIMITATION GUIDELINES FOR THE POULTRY MEAT PROCESSING INDUSTRY

I. INDUSTRY SEGMENTS

A. General Description of the Industry

As defined herein, the poultry meat processing industry comprises those establishments primarily engaged in slaughtering, dressing, cooking, smoking, rawboning, canning, freezing and dehydrating chickens, turkeys, and ducks for their own account or on a contract basis for the trade. Those plants primarily engaged in slaughtering and dressing poultry are classified under SIC Code 2016 while those primarily engaged in the preparation of processed poultry products from purchased carcasses are classified under SIC Code 2017. Establishments primarily engaged in the following SIC 2016 and 2017 activities are specifically excluded from this analysis: (1) killing, dressing, packing and further processing miscellaneous poultry (i.e., other than chickens, turkeys and ducks), rabbits and other small game and (2) drying, freezing and breaking of eggs. To avoid possible confusion, it is noted that establishments primarily engaged in the cutting-up and resale of purchased fresh poultry carcasses are classified in the trade industries and, therefore, are excluded from the analysis. Plants primarily engaged in the manufacture of soups, frozen dinners, frozen poultry pies and related specialty items are also excluded.

B. Industry Segments

As recognized in the 1972 SIC definitions, there are substantial differences between those plants which primarily slaughter poultry and those which are primarily engaged in further processing. These differences are exemplified in both the economic and effluent characteristics of the plants. In addition, the class of poultry slaughtered (i.e., young chicken,

fowl or mature chickens, turkeys and ducks) also affects the establishment's waste water treatment requirements and the firm's economic viability. In view of these factors, the following industry segments and subsegments were delineated to more realistically reflect the impact of pollution abatement requirements:

1. Establishments primarily engaged in slaughtering and dressing poultry as follows:

    a. Primarily young chickens
    b. Primarily fowl
    c. Primarily turkey
    d. Primarily ducks

2. Establishments engaged only in further processing of purchased carcasses.

3. Establishments primarily engaged in further processing but also engaged in slaughter activities.

The first major segment represents that portion of SIC 2016 covered by this analysis while the last two segments collectively represent the poultry meat processing plants in SIC 2017.

C. Number and Characteristics of Plants

Number of Plants

The preliminary 1972 Census of Manufactures report for SIC's 2016 and 2017 includes a total of 523 plants in the primarily slaughter segment (SIC 2016). Since SIC 2016 includes some plants primarily engaged in the slaughter of rabbits and other small game, the primarily poultry slaughter plants covered by this analysis is somewhat less than 523. On the basis of data available from the Census Bureau and U. S. Department of Agriculture, an estimate of 517 plants primarily engaged in chicken, turkey and duck slaughter was used in the analysis. In terms of the slaughter sub-segments, the following plant number estimates apply:

Primary Class of Slaughter	Number of Plants
Young chicken	306
Fowl	50
Turkey	144
Ducks	17

Establishments covered by SIC 2017 numbered 118 in 1972. However, the 118 include egg processing plants. The proportion of SIC 2017 establishments primarily engaged in poultry meat processing is not reported in the Census data currently available. Data relating to further processing plants inspected by the U. S. Department of Agriculture cannot be used to estimate the number of plants in these segments since those data include wholesalers, soup plants, meat and poultry pie plants, etc. Given the available published data, North Star's findings as reported in the EPA draft effluent guideline development document and data in the author's file, the following estimates were developed for this analysis: (1) further processing only--20 plants and (2) primarily further processing with slaughter--20 plants. For those further processors slaughtering, the following delineation of slaughter activities was used:

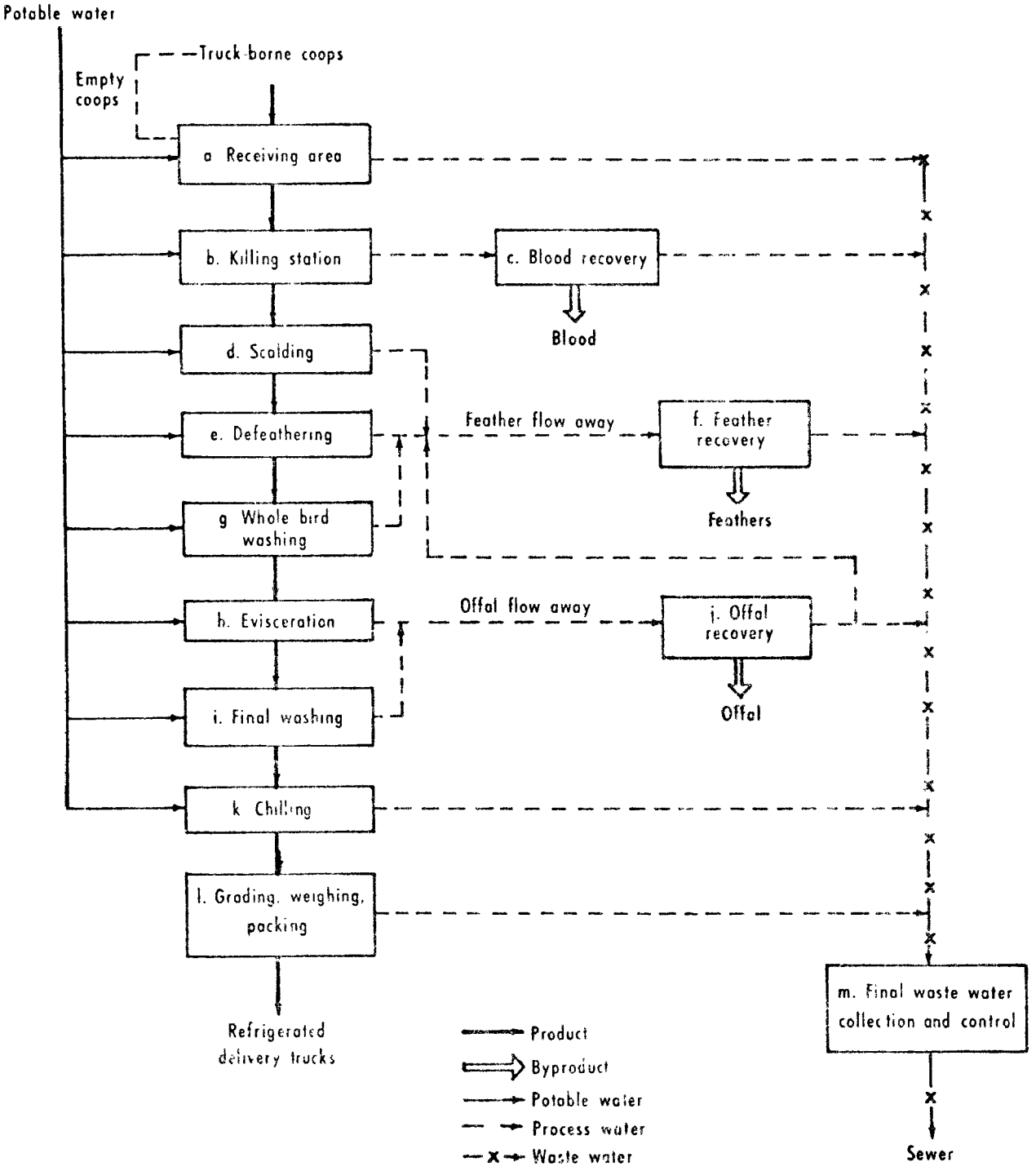
Primary Class of Slaughter	Number of Plants
Young chicken	2
Fowl	9
Turkey	9

Manufacturing Processes

The major manufacturing processes employed in a poultry slaughter plant are receiving, killing, defeathering, eviscerating, chilling, packing and shipping (Figure I-1). Additional processes such as freezing, cut-up, and storage are commonly employed in many plants. Killing is accomplished by manual or mechanical severance of the jugular vein. After killing, the birds are either tank or spray scalded and then mechanically picked. The remaining pin feathers are usually removed by hand or, in the case of ducks, a wax dip which is peeled off after it solidifies. After defeathering, the birds move to the evisceration room.

Upon entering the evisceration area, the feet are removed, the oil gland removed, and the peritoneal cavity opened. The viscera are then exposed and the carcass and entrails are inspected. The giblets are removed, trimmed, and washed while the inedible viscera is recovered for rendering or disposal. Finally, the lungs, head and neck are removed and the carcass is subjected to a final wash prior to chilling.

Figure I-1. Flow chart of poultry slaughter plant.



Source: Vertrees, James G., The Poultry Processing Industry: A Study of the Impact of Water Pollution Control Costs, Marketing Research Report No. 965, Economic Research Service, U.S. Dept. of Agriculture, Washington, D. C., June, 1972.

Manufacturing processes employed in further processing vary depending on the form of raw and finished products. Some items such as smoked chicken or turkey, cooked chicken and canned whole chicken involve a minimum of processing and no boning. Rolls and roasts require relatively few steps beyond the boning operation. Some of the more common processes employed include cooking, smoking, boning, dicing, forming, canning, freezing, packaging and shipping.

Size and Capacity Utilization

Published data concerning plant capacities and utilization are not readily available. However, industry data from our files were used to estimate plant capacities. These were then compared to annual throughput to obtain capacity utilization estimates.

Estimated 1972 capacity for primarily young chicken federally inspected slaughter plants totals 3,423 million birds per year assuming 8 hours per day, 250 operating days per year and 100 percent of capacity devoted to young chicken slaughter for all plants. That level of capacity implies an average plant utilization factor of 86 percent in 1972 and 85 percent in 1973. It is assumed that the non-federally inspected plants are small and thus, would not significantly add to the total national capacity. Also, it is assumed that the non-federally inspected plants operate at utilization levels similar to those for federally inspected plants.

As shown in Table I-1, 6,000 birds per hour is the most popular size for primarily young chicken slaughter plants. The next most popular sizes are 4,800 and 9,600 birds per hour. These three plant sizes collectively represent 61 percent of the federally inspected plants and 58 percent of the capacity. The smallest size represents 30 percent of the federally inspected plants, but accounts for only 16 percent of the capacity. This latter factor becomes even more significant given the small size of the non-federally inspected plants (18 percent of all young chicken plants are not federally inspected).

Estimated 1972 capacity for federally inspected primarily turkey slaughter plants totals 426 million birds per year assuming 8 hours per day, 250 operating days per year and 100 percent of capacity devoted to turkey slaughter. That level of capacity implies an average plant utilization factor of 28 percent in 1972 and 29 percent in 1973. In recognition of the fact that turkey slaughter is highly seasonal, if the above operating assumptions are modified to reflect 140 operating days, the total capacity is 239 million birds per year and average plant utilization is 50 and 51 percent for 1972 and 1973, respectively. As with young chickens, it is assumed that non-federally inspected plants are small and operate at capacities similar to those reported for federally inspected plants.

Table I-1 Distribution of federally inspected young chicken slaughter plants by plant size, 1972

Plant Size (Birds/hour)	Percent of Plants	Cumulative Percent of Plants	Percent of Industry's Capacity	Cumulative Percent of Capacity
≤ 1,200	1	1	<1	<1
1,500	2	3	1	1
2,400	4	8	2	2
3,000	4	12	2	4
3,600	3	15	2	6
4,000	1	15	>1	6
4,800	13	28	9	15
5,400	1	30	1	16
6,000	35	64	31	47
6,400	0	64	0	47
6,500	4	69	4	51
6,600	1	69	1	51
7,200	5	74	6	57
8,400	1	76	2	59
8,600	1	76	1	59
9,000	1	77	1	60
9,600	13	90	18	78
10,800	1	90	1	79
12,000	5	95	9	88
13,500	1	96	2	90
14,400	2	98	4	94
15,500	1	99	1	95
18,000	1	99	1	97
24,000	1	100	2	98
≥ 27,000	1	100	2	100

Source: Developed from unpublished data obtained from industry and USDA sources.

The distribution of federally inspected turkey plants and capacities is shown in Table I-2. Plants of 1,800 birds per hour capacity are by far the most common and collectively represent 46 percent of the plants and 66 percent of total capacity. Over 30 percent of the plants are smaller than 1,800 birds per hour but they account for only 20 percent of total capacity. When state inspected plants are included, the proportion of small plants becomes much larger since 18 percent of the plants are not federally inspected.

For federally inspected fowl plants, estimated total capacity is 330 million birds per year under the assumptions of 8 hours per day, 250 days per year and 100 percent of capacity devoted to fowl slaughter. The resultant average utilization of capacity for 1972 and 1973 is then estimated at 56 and 57 percent, respectively. As before, it is assumed that 18 percent of all fowl plants are not federally inspected and that those plants are small.

As shown in Table I-3, federally inspected plants with fowl capacities of 4,800 birds per hour are most common, closely followed by 3,000 birds per hour plants. The two sizes together account for 57 percent of the plants and 58 percent of total federally inspected capacity. Plants smaller than the 3,000 birds per hour represent 19 percent of the plants but only 10 percent of total capacity.

Estimated 1972 capacity for federally inspected primarily duck slaughter plants totals roughly 21 million birds per year assuming 8 hours per day, 250 operating days per year and 100 percent of capacity devoted to duck slaughter for all plants. That level of capacity implies an average plant utilization factor of 53 percent in 1972 and 52 percent in 1973. It is again assumed that non-federally inspected plants are small and operate at utilization levels similar to those for federally inspected plants.

Capacities of duck slaughter plants range from 350 birds per hour to nearly 2,500 per hour. The average capacity for federally inspected plants is about 1,600 birds per hour. Each plant seems to be rather unique with respect to plant design and no one plant size or group of plant sizes can be singled out as being more common than others.

Before entering a discussion on sizes of plants in the further processing segments, a few comments concerning the above slaughter plant data are in order. Since roughly 1 percent of the young chickens, 24 percent of the fowl and 10 percent of the turkeys slaughtered by poultry meat processing plants are slaughtered in further processing plants, the utilization figures may be overstated. However, few, if any, ducks are slaughtered by further processors. The fact that a substantial number of plants slaughter more than one class of poultry (see Product Mix discussion below) implies that utilization of capacity calculated on the assumption of 100 percent specialization (i.e., entirely single class slaughter)

Table I-2. Distribution of federally inspected turkey slaughter plants, by plant size, 1972

Plant Size (Birds/hour)	Percent of Total Plants	Cumulative Percent of Plants	Percent of Total Capacity	Cumulative Percent of Capacity
< 500	2	2	<1	<1
720	2	3	<1	1
900	8	11	4	5
1,200	10	21	6	11
1,400	11	32	9	20
1,800	46	78	46	66
2,400	14	92	19	85
3,000	6	98	11	95
≥ 5,400	2	100	5	100

Source: Developed from unpublished data obtained from industry and USDA sources.

Table I-3. Distribution of federally inspected fowl slaughter plants, by plant size, 1972

Plant Size (Birds/hour)	Percent of Plants	Cumulative Percent of Plants	Percent of Capacity	Cumulative Percent of Capacity
≤ 1,000	5	5	1	1
2,400	14	19	9	10
3,000	24	43	18	27
3,600	10	53	9	36
4,800	33	87	40	76
5,400	10	96	13	89
≥ 9,600	5	100	11	100

Source: Developed from unpublished data obtained from industry and USDA sources.

may overstate utilization for some subsegments and understate it for other subsegments. Finally, there is fairly strong evidence suggesting that some federally inspected slaughter plants do not fall within any of the categories covered by SIC's 2016 and 2017. Some may be classified as wholesalers, other manufacturers or maybe even farms (e.g. duck farms which slaughter). The extent to which this factor affects average capacity of the plants included in this study is unknown, but the direction would be toward smaller plant capacities.

Further processing plants that slaughter tend to have larger capacities on the average than do their primarily slaughter counterparts. In terms of actual annual throughput, it appears the slaughter lines in the primarily further processing plants average about 1.5 times as much young chicken as the average primarily slaughter plant, 1.7 times as much fowl, and 1.8 times as much turkey (further processors seldom slaughter ducks). A portion of the larger throughput seems to be due to higher levels of utilization in the turkey and fowl plants. After adjusting for utilization differentials, we estimate the above capacity factors to be about 1.5 for young chicken plants, 1.2 for fowl plants and 1.1 for turkey plants. The distributions of plant sizes about the mean are felt to closely approximate those for primarily slaughter plants. Further processing capacity for these plants exceeds the slaughter capacity.

On the average, further processing only plants are smaller than plants in the other two segments. In terms of purchased carcasses, the pounds of raw product throughput capacity for these plants appear to average about 50 percent of the output capacity of primarily slaughter plants. Again, substantial variance in size is found from plant to plant. Utilization of capacity in these plants is high--probably over 80 percent.

Product Mix

Although the majority of primarily slaughter plants specialize in one class of poultry, a sizeable number run mixed classes. The prevalence and degree of mixed class slaughter is shown, by subsegment, in Table I-4. Similar data for specific combinations of classes by plant size (for young chickens and turkeys) are shown in Tables I-5 through I-13. A separate table is not presented for duck plants, however, since all but one plant have specializations of 100 percent. It appears that the slaughter activities of further processing plants parallel those of primarily slaughter plants in terms of raw product mix.

Generally, primarily slaughter plants process only poultry meat products. For the group as a whole, they have a very high specialization ratio--96 percent. The major non-poultry meat item is eggs of which 14.8 million cases were purchased in 1972. As of November of 1973, only 37 plants which slaughtered poultry in federally inspected plants also held permits for processing red meat (Table I-14). Many of the plants are involved in

cut-up and further processing of poultry carcasses. A high percentage of the plants cut-up the lower quality birds. Over 25 percent of the young chickens slaughtered are cut up while about 17 percent of the turkeys are cut up. These data exclude cut-up activities of wholesalers and retailers. About 10 percent of the young chicken and 78 percent of the turkeys are frozen.

About 99 percent of the young chickens are sold as broilers and fryers with the remainder being primarily roasters and capons. Of the broilers and fryers sold in fresh form (i.e., not frozen), 75 percent are wet ice packed, 11 percent and 14 percent as chilled consumer packaged. Of the turkeys, 94 percent are young mature birds, 5 percent fryer-roasters and 1 percent old mature birds.

The major products produced in further processing plants, in order of relative importance, includes cooked or smoked turkey, cooked or smoked chicken and canned poultry. These products collectively represent nearly 99 percent of poultry meat items classified in SIC 2017. The specialization ratio of 90 percent for these plants (which includes egg processing) suggests some plants also produce other poultry meat items such as soups and pies. Within the general product categories listed above, a vast array of specific products are produced.

The bulk of further processed turkey is sold in the form of roasts, 4-5 pound packages of raw meat for the retail trade, 10-12 pound packages of cooked rolls for the institutional trade, bulk meat and parts, and frozen turkey dinners and pies. Turkey rolls were introduced in the early 1960's and, during recent years, have been the largest volume further processed turkey product.

The most popular further processed young chicken and fowl products include canned whole chicken, canned meat, bulk meat and parts, soup, frozen chicken dinners, pies, and specialty items such as chicken sticks, croquettes, franks, and bologna.

Table I-4. Number of slaughter plants, by subsegment, by degree of specialization, 1972

Primary Class as Percent of Total Slaughter	Subsegment				
	Primarily Young Chicken	Primarily Fowl	Primarily Turkey	Primarily Ducks	Total
	(Number of plants)				
20-30					
31-40					
41-50	4	0	1	0	5
51-60	0	2	0	0	2
61-70	10	6	3	0	19
71-80	15	3	4	0	22
81-90	13	4	4	0	21
91-95	21	2	7	1	31
96-99	37	10	6	0	53
99.1-100	206	23	119	16	364
Total	306	50	144	17	517

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-5. Number of all young chicken plants by degree of specialization and classes slaughtered, 1972.

Classes Slaughtered	Percent of Total Annual Slaughter as Young Chickens								
	41-50	51-60	61-70	71-80	81-90	91-95	96-98	99.1-100	Total
	(Number of plants)								
C (chickens) only								155	155
C + F (fowl)			1	3	5	11	28	48	96
C + T (turkeys)			1	1	3	3	2	3	13
C + O (other)			2						2
C + F + T	3		4	8	5	7	5		32
C + F + O				2					2
C + T + O							2		2
C + F + T + O	1		2	1					4
Total	4		10	15	13	21	37	206	306

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-6. Number of small young chicken plants by degree of specialization and classes slaughtered, 1972 1/.

Classes Slaughtered	Percent of Total Annual Slaughter as Young Chickens								
	41-50	51-60	61-70	71-80	81-90	91-95	96-99	99.1-100	Total
	(Number of plants)								
C (chickens) only								70	70
C + F (fowl)				3	5	6	13	19	46
C + T (turkeys)			1		3	2	2	2	10
C + O (other)			2						2
C + F + T	3		4	6	4	3	3		23
C + F + O				2					2
C + T + O							2		2
C + F + T + O			2						2
Total	3		9	11	12	11	20	91	157

1/ Small plants defined as those with annual volumes of less than 35,435,000 pounds of young chickens slaughtered.

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-7. Number of medium young chicken plants by degree of specialization and classes slaughtered, 1972[1/].

Classes Slaughtered	Percent of Total Annual Slaughter as Young Chickens								
	41-50	51-60	61-70	71-80	81-90	91-95	96-99	99.1-100	Total
	(Number of plants)								
C (chickens) only								40	40
C + F (fowl)			1			1	7	16	25
C + T (turkeys)				1					1
C + O (other)									0
C + F + T				1	1	3	1		6
C + F + O									0
C + T + O									0
C + F + T + O	1								1
Total	1		1	2	1	4	8	56	73

1/ Medium plants defined as those with annual volumes of 35,435,000 to 56,696,000 pounds of young chickens slaughtered.

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-8. Number of large young chicken plants by degree of specialization and classes slaughtered, 1972[1/].

Classes Slaughtered	Percent of Total Annual Slaughter as Young Chickens								
	41-50	51-60	61-70	71-80	81-90	91-95	96-99	99.1-100	Total
	(Number of plants)								
C (chickens) only								18	18
C+F (fowl)						4	6	8	18
C + T (turkeys)						1			1
C + O (other)									0
C + F + T						1	1		2
C + F + O									0
C + T + O									0
C + F + T + O				1					1
Total				1		6	7	26	40

1/ Large plants defined as those with annual volumes of 56,696,000 to 73,854,000 pounds of young chickens slaughtered.

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-9. Number of very large young chicken plants by degree of specialization and classes slaughtered, 1972 1/.

Classes Slaughtered	Percent of Total Annual Slaughter as Young Chickens								
	41-50	51-60	61-70	71-80	81-90	91-95	96-99	99.1-100	Total
	(Number of plants)								
C (chickens) only								27	27
C + F (fowl)							2	5	7
C + T (turkeys)								1	1
C + O (other)									0
C + F + T				1					1
C + F + O									0
C + T + O									0
C + F + T + O									0
Total				1			2	33	36

1/ Very large plants defined as those with annual volumes of over 73,854,000 pounds of young chickens slaughtered.

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-10. Number of total turkey plants by degree of specialization and classes slaughtered, 1972[1/]

Classes Slaughtered	Percent of total annual slaughter as turkeys								
	41-50	51-60	61-70	71-80	81-90	91-95	96-99	99.1-100	Total
	(Number of plants)								
T (turkeys) only								111	111
T + F (fowl)					2	1	3	5	11
T + C (chickens)				1		4	1	3	9
T + O (other)					1	1			2
T + F + C			3	3	1	1			8
T + F + O									
T + C + O									
T + F + C + O	1						2		3
Total	1		3	4	4	7	6	119	144

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-11. Number of small turkey plants by degree of specialization and classes slaughtered, 1972[1/].

Classes Slaughtered	Percent of total annual slaughter as turkeys								
	41-50	51-60	61-70	71-80	81-90	91-95	96-99	99.1-100	Total
	(Number of plants)								
T (turkeys) only								69	69
T + F (fowl)					2		1	3	6
T + C (chickens)				1		4	1		6
T + O (other)					1	1			2
T + F + C			3	2	1	1			7
T + F + O									
T + C + O									
T + F + C + O	1						2		3
Total	1		3	3	4	6	4	72	93

[1/] Small plants defined as those with annual volumes of less than 17,317,000 pounds of turkeys slaughtered.

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-12. Number of medium and large turkey plants by degree of specialization and classes slaughtered, 1972 [1/] [2/].

Classes Slaughtered	Percent of total annual slaughter as turkeys								
	41-50	51-60	61-70	71-80	81-90	91-95	96-99	99.1-100	Total
				(Number of plants)					
T (turkeys) only								33	33
T + F (fowl)						1	2	1	4
T + C (chickens)								3	3
T + O (other)									
T + F + C				1					1
T + F + O									
T + C + O									
T + F + C + O									
Total				1		1	2	37	41

1/ Medium and large plants defined as those with annual volumes of 17,317,000 - 46,620,000 and over 46,620,000 pounds of turkeys slaughtered, respectively

2/ All 10 large turkey plants have in excess of 99 percent of the annual slaughter as turkeys.

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-13. Distribution of all fowl plants by degree of specialization and classes slaughtered, 1972.

Classes Slaughtered	Percent of total annual slaughter as fowl								
	41-50	51-60	61-70	71-80	81-90	91-95	96-99	99.1-100	Total
	(Number of plants)								
F (fowl) only								13	13
F + C (chickens)			4	1	4	2	9	10	30
F + T (turkeys)		1							1
F + O (other)									0
F + C + T		1	1	2			1		5
F + C + O									0
F + T + O									0
F + C + T + O			1						1
Total		2	6	3	4	2	10	23	50

Source: Developed from unpublished data provided by industry and USDA sources.

Table I-14. Number of federally inspected poultry slaughter plants with red meat inspection permits, by type of plant, 1973.

Type of Red Meat Operations	Number of Plants
Slaughter only	1
Slaughter, process	3
Slaughter, process, bone	10
Process only	20
Process, bone	3
Total	37

Source: Unpublished data provided by USDA.

Seasonality

Seasonal variations in production are one of the factors causing rather low utilization of capacity in some of the subsegments of the poultry meat processing industry. In the slaughter segment, young chickens show only modest seasonal variation with the low and high monthly slaughter ranging from 89 to 113 percent of the average monthly volume (Table I-15). Fowl slaughter is only slightly more seasonal with monthly totals ranging from 77 to 114 percent of the average. Ducks show substantial seasonal variations with the monthly totals ranging from 47 to 146 percent of the average. Turkey slaughter is the most seasonal with the low and high months equalling 30 and 188 percent of the average monthly volume, respectively.

As shown in Table I-16, further processing is more stable than is slaughter. Young chicken meat further processing is rather stable, fowl meat more seasonal and turkey meat very seasonal. The degree of seasonality in turkey slaughter and processing has concerned the industry for a long time but efforts to level out consumer demand have met with only modest success.

Age

Published data concerning the age of poultry meat processing plants is not readily available. It is known that large numbers of both old and relatively new plants are currently operating. However, a useful indicator of plant age is the fact that most plants in operation prior to 1960 had to be replaced or substantially rejuvenated in the early 1960's due to federal inspection requirements. Another period of rapid, plant construction occurred in the mid to late 1960's. Construction of new plants since 1970 has been minimal. As a result, an average plant age of 12 years has been assumed for all segments in this analysis.

Location

For plants in the slaughter segment, there is a high correlation between location of live bird production and location of plants. The Southern region has the largest numbers of young chicken plants (Table I-16). The largest concentration of fowl and turkey plants is in the North Central region. Duck plants are split between the Northeastern and North Central regions.

Plants in the further processing segments tend to be located in roughly the same fashion as are turkey slaughter plants. The North Central region has the largest concentration of further processing plants.

Table I-15. Monthly distribution of federally inspected poultry slaughter, 1972

Month	Total percent of annual slaughter			
	Young chicken	fowl	turkeys	ducks
January	7.9	9.5	3.2	4.1
February	7.6	9.2	2.5	3.9
March	8.3	9.1	2.5	4.7
April	8.0	8.8	2.5	8.4
May	9.1	8.1	4.2	11.2
June	9.1	8.6	8.3	12.2
July	8.1	6.4	10.4	10.2
August	9.4	8.2	14.2	11.4
September	8.1	7.4	13.5	9.6
October	8.9	8.6	15.7	9.6
November	7.9	8.5	14.5	8.6
December	7.4	7.5	8.5	6.3
1/ Total	100	100	100	100

1/ May not total 100 due to rounding error.
Source: Poultry and Egg Situation, April, 1974.

Table I-16. Monthly distribution of poultry further processing in federally inspected plants, 1972

Month	Percent of total annual volume		
	Young chicken meat	Fowl meat	Turkey meat
January	7.8	8.1	5.3
February	8.2	8.9	5.6
March	8.7	10.0	6.2
April	7.8	9.3	5.4
May	8.5	10.0	6.1
June	8.6	8.9	9.0
July	7.6	6.8	9.8
August	8.8	8.2	11.6
September	8.2	6.9	11.0
October	9.0	7.8	12.5
November	8.4	7.9	10.8
December	8.5	7.4	7.5
Total 1/	100.0	100.0	100.0

1/ May not total 100 due to rounding.
Source: Poultry & Egg Situation, April, 1973.

Table I-17. Location of poultry slaughter plants by regions, divisions and states, 1972

Region/Division/State	Number of plants by primary class of slaughter				
	Total	Young chickens	Fowl	Turkey	Ducks
U. S. Total	517	306	50	144	17
Northeast Region	55	23	7	16	9
New England Division	12	7	2	2	1
Maine	5	5	0	0	0
New Hampshire	1	0	0	1	0
Vermont	1	0	1	0	0
Massachusetts	3	0	1	1	1
Rhode Island	1	1	0	0	0
Connecticut	1	1	0	0	0
Middle Atlantic Division	43	16	5	14	8
New York	10	0	2	1	7
New Jersey	6	2	3	0	1
Pennsylvania	27	14	0	13	0
North Central Region	132	43	19	64	6
East North Central Division	70	28	8	28	6
Ohio	19	6	4	8	1
Indiana	20	9	1	8	2
Illinois	13	5	2	5	1
Michigan	6	3	0	3	0
Wisconsin	12	5	1	4	2
West North Central Division	62	15	11	36	0
Minnesota	19	2	4	13	0
Iowa	12	2	1	9	0
Missouri	22	10	3	9	0
North Dakota	0	0	0	0	0
South Dakota	1	0	0	1	0
Nebraska	5	0	3	2	0
Kansas	3	1	0	2	0

Table I-17 (continued)

Region/Division/State	Number of plants by primary class of slaughter				
	Total	Young chickens	Fowl	Turkey	Ducks
South Region	250	210	13	26	1
South Atlantic Division	105	87	5	12	1
Delaware	6	6	0	0	0
Maryland	12	10	1	1	0
District of Columbia	0	0	0	0	0
Virginia	12	8	0	3	1
West Virginia	4	4	0	0	0
North Carolina	31	25	1	5	0
South Carolina	7	5	0	2	0
Georgia	28	25	3	0	0
Florida	5	5	0	0	0
East South Central Division	60	55	4	1	0
Kentucky	1	1	0	0	0
Tennessee	8	7	1	0	0
Alabama	27	27	0	0	0
Mississippi	19	15	3	1	0
Puerto Rico	5	5	0	0	0
West South Central Division	85	67	4	14	0
Arkansas	33	30	1	2	0
Louisiana	11	9	1	1	0
Oklahoma	6	4	0	2	0
Texas	35	24	2	9	0
West Region	80	30	11	38	1
Mountain Division	18	4	4	10	0
Montana	0	0	0	0	0
Idaho	4	3	1	0	0
Wyoming	1	0	1	0	0
Colorado	7	1	1	5	0
New Mexico	0	0	0	0	0
Arizona	0	0	0	0	0
Utah	6	0	1	5	0
Nevada	0	0	0	0	0
Pacific Division	62	26	7	28	1
Washington	7	5	0	2	0
Oregon	9	8	0	1	0
California	46	13	7	25	1
Alaska	0	0	0	0	0
Hawaii	0	0	0	0	0

Data published by USDA indicate that over 70 percent of all federally inspected poultry slaughter plants are located within municipalities (Table I-18). However, substantial regional variation exists ranging from 52 percent in the East North Central Region to 96 percent in the West North Central Region. Variations by plant size also exist.

The location of federally inspected poultry slaughter plants with respect to size of population center is also available from USDA data. In 1970, nearly 50 percent of the plants were located in centers of less than 5,000 population. Over 75 percent were located in centers of less than 20,000 population. As shown in Table I-19, substantial regional variations are again prevalent as are variations by plant size.

D. Concentration and Integration

The poultry meat processing industry exhibits the rather unique combination of low market concentration and high vertical integration. The market shares of the 4, 8, 20 and 50 largest firms in 1967 and earlier years are shown in Table I-20. The trend toward increased concentration is continuing. For example, USDA data reported the 4, 8, and 20 largest firms accounted for 32, 46, and 72 percent of the total federally inspected turkey slaughters in 1972.

The high level integration on the part of some firms in the industry can be seen by examining Figure I-2. The typical broiler firm often has its own hatchery, feed mill, processing plant and control of production or company farms and/or contract producers' farms. Although many firms are not fully integrated, virtually all young chicken plants combine two or more major functions. More than 95 percent of all commercial broilers are grown under contract or by company owned farms. The firm may be independent, a subsidiary of a national feed company or meatpacker, or part of a large conglomerate corporation.

Vertical integration is important in the turkey slaughter subsegment but is of a different nature than in the young chicken subsegment. Processors have been the major coordinators in the turkey industry while feed firms have been the most important coordinators in the young chicken industry. Also, grower cooperatives have been more important in the turkey industry. In 1972 USDA data shows 42 percent of the turkey's were produced under contract, 12 percent by farms owned by integrated enterprises and 18 percent through marketing agreements between cooperatives and processors. The total of 72 percent of the production being coordinated is indeed high by most standards but significantly lower than is true for young chickens.

Table I-18. Location of USDA surveyed federally inspected poultry slaughtering plants relative to municipal limits, by size of plant and region, 1970.

Plant size and location	Region						
	North Atlantic	East North Central	West North Central	South Atlantic	South Central	West	All
	Number of plants						
Small:							
Within....	10	12	12	2	11	14	61
Outside...	9	11	1	4	2	5	32
Total...	19	1/24	13	6	13	19	1/94
Medium:							
Within....	5	9	34	29	59	20	156
Outside...	8	8	1	20	11	6	54
Total...	13	1/18	35	1/51	70	1/30	1/217
Large:							
Within....	5	--	--	22	29	--	56
Outside...	1	--	--	11	5	--	17
Total...	6	--	--	1/34	1/35	--	1/75
All.....	38	42	48	91	118	49	386

1/ Differences in total and components exist because some plants did not indicate location.

Source: Vertrees, James G., The Poultry Processing Industry: A Study of the Impact of Water Pollution Control Costs, Marketing Research Report No. 965, Economic Research Service, U. S. Department of Agriculture in cooperation with the Environmental Protection Agency, Washington, D. C., June, 1972.

Table I-19. Location of USDA surveyed federally inspected poultry slaughtering plants, by size of population center and by region and size of plant, 1970.

Region and plant size	Size of population center								
	0-999	1,000-2,499	2,500-4,999	5,000-9,999	10,000-19,999	20,000-29,999	30,000-39,999	40,000 & over	All
	Number of plants								
North Atlantic:									
Small	9	7	--	1	1	--	--	1	19
Medium	4	5	1	--	2	--	--	1	13
Large	1	--	1	2	--	1	--	1	6
Total	14	12	2	3	3	1	--	3	38
East North Central:									
Small	7	4	5	2	2	2	1	1	24
Medium	5	5	4	2	1	--	--	1	18
Large	--	--	--	--	--	--	--	--	--
Total	12	9	9	4	3	2	1	2	42
West North Central:									
Small	2	--	3	4	1	--	--	3	13
Medium	1	11	3	9	5	3	2	1	35
Large	--	--	--	--	--	--	--	--	--
Total	3	11	6	13	6	3	2	4	48
South Atlantic:									
Small	2	1	1	--	--	2	--	--	6
Medium	11	11	5	7	9	1	--	7	51
Large	6	10	2	3	7	1	--	5	34
Total	19	22	8	10	16	4	--	12	91
South Central:									
Small	1	--	--	3	3	--	--	6	13
Medium	4	13	11	8	13	3	4	14	70
Large	3	7	7	5	5	4	--	4	35
Total	8	20	18	16	21	7	4	24	118
West:									
Small	1	2	2	5	--	1	1	7	19
Medium	3	2	1	5	5	2	--	12	30
Large	--	--	--	--	--	--	--	--	--
Total	4	4	3	10	5	3	1	19	49
Total	60	78	46	56	54	20	8	64	386

Source: Vertrees, James G., The Poultry Processing Industry: A Study of the Impact of Water Pollution Control Costs, Marketing Research Report No. 965, Economic Research Service, U. S. Dept. of Agriculture in cooperation with the Environmental Protection Agency, Washington, D. C., June, 1972.

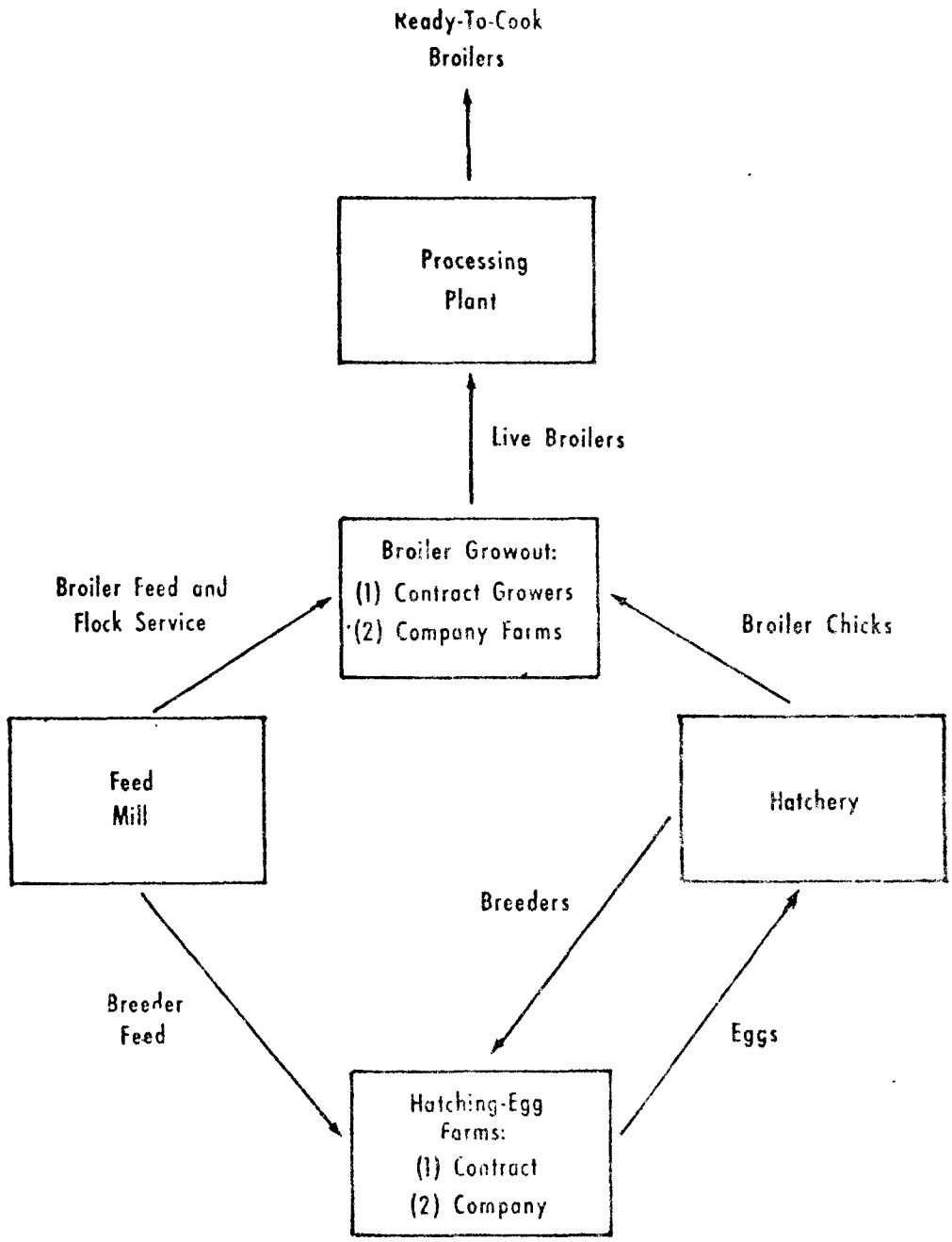
Table I-20. Percent of value of shipments of each class or products accounted for by the largest companies: 1967 compared with 1963, 1958, and 1954

Code [1/]	Class of products and year		Value of shipments			
			Percent accounted for by			
			4 largest companies	8 largest companies	20 largest companies	50 largest companie
2015	Poultry dressing plant products	1967	15	23	35	51
		1963	13	19	30	47
		1958	12	16	25	41
20151	Hens (or fowl) and chickens	1967	17	26	40	60
		1963	14	21	36	55
		1958	12	17	29	48
		1954	18	25	35	NA
20153	Turkeys	1967	28	39	61	87
		1963	23	35	56	85
		1958	23	32	52	79
		1954	22	31	49	NA
20154	Processed poultry, except soups	1967	50	65	90	100
		1963	40	68	94	100
		1958	--	--	--	--
20155	Other poultry and small game	1967	81	91	99+	100
		1963	83	89	98	100
		1958	44	58	81	96

[1/] The SIC Code 2015, as used in 1967, was subsequently divided into two separate SIC's: 2016 and 2017.

Source: 1967 Census of Manufactures.

Figure I-2. Functions of a fully integrated broiler firm.



Source: Faber, Fred L., and Ruth J. Irvin, The Chicken Broiler Industry: Structure, Practices, and Costs, Marketing Research Report No. 930, Economic Research Service, U. S. Dept. of Agriculture, Washington, D. C., May, 1971.

Like the young chicken and turkey subsegments, duck and fowl operations are also subject to integration. Most ducks are slaughtered by firms controlling production through company farms and contracts or by cooperatives. Fowl is less subject to integration than the other subsegments due to its relationship with egg layer operations.

Many further processors are also integrated. Indications are that these segments probably parallel the slaughter subsegments in this regard.

E. Employment

Employment in SIC's 2016 (poultry slaughter) and 2017 (poultry further processing and egg processing) appear in Table I-21 (note that prior to 1972, SIC's 2016 and 2017 were combined in SIC 2015). Published data for only the further processing portions SIC 2017 are not available. However, our estimates for 1972 employment in the two further processing segments are 9,600 with 8,500 of these being production workers.

Hourly earnings of production workers in poultry and egg processing plants appear in Table I-22. Relative earnings by plant type appear in Table I-23. The earnings are low for all types of plants when compared to other industries. By comparing Tables I-22 and I-24, it can be seen that hourly earnings in poultry and egg processing plants were only 67 percent of the average for all food manufactures in 1972. This fact coupled with the geographic location of poultry meat processing plants suggests that the employees probably have few alternative sources of employment.

In terms of labor productivity published data suggest few significant gains have been made in recent years. In fact, it appears that productivity has remained constant or, perhaps, has declined slightly in the industry since 1967 (Table I-25). At the same time, however, value added per manhour of production labor has been rising (Table I-26). Payrolls as a percent of value added in 1972 was roughly at the same level as in 1967. As should be expected, payrolls represent a larger share of value added in slaughter plants than in further processing plants.

Employment and financial data for establishments in different employment size classes are shown in Table I-27.

Table I-21. Number of total employees and production workers in the poultry and egg processing industries (SIC 2016 and 2017)

Year	All Employees (1,000)	Production Workers (1,000)
1962	66.9	61.9
1963	70.1	63.8
1964	71.3	64.8
1965	72.2	65.4
1966	75.2	68.2
1967	85.2	77.2
1968	87.6	79.4
1969	91.9	83.5
1970	92.9	84.4
1971	90.1	81.5
1972	93.0	85.0
SIC 2016	79.3	72.7
SIC 2017	13.7	12.3

Source: 1972 Census of Manufactures

Table I-22. Hourly earnings of production workers in poultry and egg processing plants, 1958-72

Year	SIC 2015	SIC 2016	SIC 2017
	$/hour		
1958	1.27		
1959	1.27		
1960	1.31		
1961	1.31		
1962	1.36		
1963	1.41		
1964	1.47		
1965	1.51		
1966	1.62		
1967	1.76	1.74 */	1.85 */
1968	1.87		
1969	1.98		
1970	2.14		
1971	2.26		
1972	2.42	2.41	2.50

*/ Estimated by Development Planning and Research Associates, Inc.

Source: 1972 Census of Manufactures

Table I-23. Index of hourly earnings of production workers in poultry meat processing plants, by type of plant, 1967

Plant type	Index
	(SIC 2015 = 100)
All poultry and egg processors	100.0
Young chicken and fowl	0.97
Turkey	1.06
Other poultry and small game	1.14
Further processing	1.09

Source: 1967 Census of Manufactures

Table I-24. Hourly earnings of employees of firms marketing food, annual 1958-72, monthly 1972-73

Year and month	Food manufacturers	Food wholesalers	Retail food stores	Food marketing 1/	Eating & drinking places
	Dollars				
1958	1.94	1.89	1.59	1.82	---
1959	2.02	1.97	1.60	1.88	---
1960	2.11	2.03	1.68	1.96	---
1961	2.17	2.09	1.76	2.03	---
1962	2.24	2.16	1.83	2.10	---
1963	2.30	2.23	1.90	2.16	---
1964	2.37	2.28	1.98	2.23	1.25
1965	2.43	2.36	2.05	2.30	1.30
1966	2.52	2.50	2.13	2.40	1.40
1967	2.64	2.66	2.23	2.52	1.49
1968	2.79	2.83	2.38	2.67	1.62
1969	2.95	3.00	2.54	2.84	1.73
1970	3.16	3.31	2.70	3.03	1.85
1971	3.38	3.47	2.90	3.24	1.95
1972	3.60	3.66	3.09	3.45.	2.02

1/ Weighted composite earnings of production employees in food manufacturing and nonsupervisory employees in wholesale and retail food trade calculated by the Economic Research Service from data of the U.S. Department of Labor.

Source: Marketing and Transportation Situation, U. S. Department of Agriculture, Washington, November, 1973.

Table I-25. Output per man-hour in establishments manufacturing farm originated foods, by industry, 1960-72 1/ (1967 = 100)

Year	Output	Man-hours	Output per man-hour	Output	Man-hours	Output per man-hour	Output	Man-hours	Output per man-hour
	All foods 2/			Meat products 3/			Poultry and eggs 4/		
1960 ..	83	105	79	81	108	75	62	79	78
1961 ..	86	104	83	82	104	78	73	86	84
1962 ..	88	102	87	83	102	81	72	81	89
1963 ..	91	99	92	87	101	86	76	86	88
1964 ..	95	101	94	94	108	87	80	88	91
1965 ..	96	99	97	91	101	91	85	91	93
1966 ..	98	99	99	96	99	97	92	95	97
1967 ..	100	100	100	100	100	100	100	100	100
1968 ..	103	99	104	103	98	105	96	102	94
1969 ..	103	100	103	103	97	106	102	109	94
1970 ..	104	98	106	106	97	109	114	123	93
1971 ..	105	96	110	110	97	113	117	121	96
1972 ..	105	96	110	108	97	111	120	127	95
	Dairy products 5/			Processed fruits and vegetables 6/			Grain-mill products 7/		
1960 ..	93	121	77	73	92	79	84	108	77
1961 ..	95	119	80	78	93	85	87	107	82
1962 ..	96	114	85	85	93	91	91	106	86
1963 ..	99	109	91	82	91	90	96	99	97
1964 ..	100	108	93	87	93	94	98	101	98
1965 ..	101	105	97	91	96	95	98	99	98
1966 ..	100	101	99	96	99	97	100	99	102
1967 ..	100	100	100	100	100	100	100	100	100
1968 ..	100	95	105	109	102	106	103	99	104
1969 ..	99	92	107	104	105	99	104	98	106
1970 ..	98	88	110	108	101	106	104	95	109
1971 ..	99	85	116	108	98	111	105	95	111
1972 ..	101	82	123	108	100	108	106	94	111

1/ Output per man-hour indexes were computed from unrounded indexes of man-hours worked by all employees and factory output. Man-hour estimates for 1960-71 are based on data published by the Bureau of Census. Estimates for 1972 were interpolated from employment statistics published by BLS. Output estimates are based on value-added indexes published by the Bureau of Census projected for nonCensus years by physical output data published by the USDA. Data for 1964-72 are preliminary. 2/ Establishments primarily engaged in manufacturing shortening and cooking oils, margarine, macaroni, and spaghetti, as well as industry groups shown on this table. 3/ Meat packing plants and establishments specializing in prepared meat products. 4/ Poultry-dressing plants and establishments specializing in processed egg products. 5/ Plants engaged in processing fluid milk and cream, butter, natural cheese, concentrated milk, ice cream and ices, and special dairy products. 6/ Establishments primarily engaged in canning and freezing fruits and vegetables and manufacturing pickles and sauces. 7/ Establishments primarily engaged in manufacturing flour and meal, cereal products, rice milling, blended and prepared flour, and corn wet milling products.

Source: Marketing and Transportation Situation, U.S. Department of Agriculture, Washington, November, 1973.

Table I-26. Selected employment related operating ratios for poultry and egg processing plants, 1958-1972

Year	Payroll per employee	Production worker as percent of total employment	Annual man-hours of production workers	Acreage hourly earnings of production workers	Cost of materials per dollar of shipments	Cost of materials and payrolls per dollar shipments	Value added per employee	Payrolls as percent of value added	Value added per man-hour of production worker
	(dollars)	(percent)	(number)	(dollars)	(dollars)	(dollars)	(dollars)	(percent)	(dollars)
1958	2,578	90	1,856	1.27	.84	.92	4,978	52	2.98
1959	2,589	92	1,819	1.27	.82	.91	4,998	52	2.98
1960	2,628	93	1,792	1.31	.83	.91	5,444	48	3.28
1961	2,729	92	1,863	1.31	.82	.91	5,159	53	3.01
1962	2,842	93	1,861	1.36	.82	.91	5,595	51	3.25
1963	2,916	91	1,883	1.41	.82	.91	5,861	50	3.42
1964	3,067	91	1,906	1.47	.82	.91	5,917	52	3.42
1965	3,213	91	1,947	1.51	.81	.91	6,450	50	3.65
1966	3,501	91	1,965	1.62	.80	.90	7,439	47	4.17
1967	3,723	91	1,929	1.76	.80	.91	6,922	54	3.93
1968	3,920	91	1,914	1.87	.79	.90	7,492	52	4.31
1969	4,221	91	1,945	1.98	.76	.87	8,980	47	5.08
1970	4,579	91	1,962	2.14	.76	.88	9,153	50	5.14
1971	4,350	90	1,893	2.26	.75	.86	9,883	44	5.77
1972	5,144	91	1,945	2.42	.77	.89	9,790	53	5.50
SIC 2016									
1972	5,119	92	1,953	2.41	.78	.90	9,440	54	5.27
SIC 2017									
1972	5,292	90	1,894	2.50	.71	.84	11,817	45	6.94

Source: 1967-1972 Census of Manufactures

Table I-27. General statistics, by employment size of establishment, 1967

2015 Poultry Processing Plants	Establishments	All employees		Production workers			Value added by manufacture	Cost of materials	Value of shipments	Capital expenditure new	End of year inventories	Average value of shipments per firm
		Number	Payroll	Number	Man-hours	Wages						
	(number)	(1,000)	(mil dol)	(1,000)	(millions)	(mil dol)	(mil dol)	(mil dol)	(mil dol)	(mil dol)	(mil dol)	(1,000 dol)
Establishments, Total	843	85.2	317.1	77.7	149.9	263.5	588.0	2,358.5	2,936.1	57.2	135.6	3,482.9
Establishments with an average of												
1 to 4 employees	188	.3	1.1	.3	.5	.9	4.6	13.0	17.6	4.1	.9	93.6
5 to 9 employees	86	.6	2.0	.5	.9	1.6	5.8	15.7	21.5	.5	.9	250.0
10 to 19 employees	55	.8	2.9	.7	1.1	2.3	8.3	30.3	38.5	.6	1.1	700.0
20 to 49 employees	99	3.3	12.5	2.9	5.3	9.9	32.7	98.9	131.0	1.7	5.9	1,323.2
50 to 99 employees	126	9.2	33.2	8.4	15.1	27.0	71.2	250.2	318.8	9.7	18.4	2,530.2
100 to 249 employees	192	30.5	113.3	27.7	53.1	93.3	199.8	920.9	1,114.5	16.3	43.9	5,804.7
250 to 499 employees	80	28.3	106.1	25.9	52.0	89.3	191.1	811.5	1,002.2	17.3	43.3	12,527.5
500 to 999 employees	15	12.2	45.9	11.2	21.9	39.2	74.3	218.0	292.0	7.1	21.4	19,466.7
1,000 to 2,499 employees	2	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Establishments covered by Admin. Records	233	.8	2.5	.8	1.2	2.0	8.2	25.0	33.2	.9	1.7	

(D) Withheld to avoid disclosing figures for individual companies

Source: 1967 Census of Manufactures

II. FINANCIAL PROFILE OF THE INDUSTRY

Most firms in the poultry processing industry are either closely held corporations or operating divisions of larger corporations. In the former group, financial information is proprietary and unavailable for analysis. In the latter group, the poultry processing information is consolidated with other divisions and therefore difficult to assess. In both groups a high degree of integration of poultry operations further compounds the difficulty of evaluating the processing sector.

Little published aggregate financial data for the poultry meat processing industry per se is available. Census includes the egg processing and small game dressing segments with the poultry processing industry. USDA data are not compatible with SIC definitions. Similar problems exist with other sources of data. Since the egg processing and small game dressing segments represent a very small portion of the total industry as reported by Census (about 5 percent of the value of shipments), that data source provides the best published information of the industry as defined in this report.

Supplementary information was obtained from the various trade associations, equipment suppliers, consulting engineers and operating executives within the industry.

A. Sales

The contribution that different output categories made to total sales of SIC 2015 in 1967 are shown in Table II-1.

Total sales of the poultry industry were $3,874 million in 1972 (Table II-2). This compared to $2,936.1 million in 1967 and $1,888.2 million in 1958. The increase of total sales over the 1958-1972 period reflects consumption expanding faster than the rate of decline in wholesale prices. Per capita chicken consumption increased from 28.2 pounds in 1958 to 42.9 pounds in 1972. During the same period, turkey consumption increased from 5.9 pounds to 9.1 pounds per capita. The increase in consumption undoubtedly reflects increased quality of product as well as declining prices. The farm price of broilers declined from 18.5 cents to 14.3 cents per pound from 1958 to 1972. Turkeys were somewhat more stable with a farm price of 23.9 cents in 1958 and 22.2 cents in 1972.

Table II-1. Value of shipments by product class, SIC 2015, 1967

Product Code	Product Class	Value of shipments (million dollars)
2011	Meatpacking plants	(under 2)
20111	Beef, not canned or made into sausage	-
20112	Veal, not canned or made into sausage	-
20113	Lamb and mutton, not canned or made into sausage	-
20114	Pork, fresh and frozen	-
20115	Lard	-
20119	Hides, skins, and pelts	(under 2)
20110	Miscellaneous by products of meat-packing plants	(under 2)
2013	Sausages and other prepared meats	(under 2)
20116	Pork, processed or cured	(under 2)
20136		
20117	Sausage and similar products	(Z)
20137		
20118	Canned meats (except dog and cat food)	
20138	containing 20 percent or more meat	(under 2)
20139	Natural sausage casings	-
20130	Meat processing plant products, n.s.k.	1.0
2015	Poultry Products	2,752.4
20151	Hens (or fowl) and chickens	1,831.8
20153	Turkeys	491.6
20154	Processed poultry, except soups	133.5
20155	Other poultry and small game	(10-20)
20156	Liquid, dried, and frozen eggs	151.9
20150	Poultry dressing plant product, n.s.k.	(100-200)
2021	Creamery butter	6.3
2023	Condensed and evaporated milk	(2-5)
2032	Canned specialties	(under 2)
2037	Frozen fruits and vegetables	6.7
2042	Prepared feeds	(5-10)
2051	Bread, cake and related products	(over 2)
2094	Animal and marine fats and oils	2.2
2096	Shortening and cooking oils	-
2099	Food preparations, n.e.c.	-
2891	Adhesives and gelatin	-
3079	Miscellaneous plastic products	-

Table II-1.(continued)

Product Code	Product Class	Value of shipments (million dollars)
	other secondary products	6.2
	miscellaneous receipts	146.5
93000	Commission receipts	11.2
99989	Resales	95.9
95120	Shell egg sales	20.6
99980	Other miscellaneous receipts	18.8
	TOTAL	2,936.1

(z) Less than $50 thousand

Source: 1967 Census of Manufactures

Table II-2. Value of shipments, poultry and egg processing industry, 1962-1973 (million dollars)

Year	Number of establishments	SIC 2015	SIC 2016 2/	SIC 2017 2/	Average sales/ establishment
1973		5,000.0 1/			
1972	641	3,874.3	3,322.0	552.3	6.044
1971		3,488.8			
1970		3,456.9			
1969		3,466.7			
1968		3,071.4			
1967	843	2,936.1			3.483
1966		2,754.1			
1965		2,490.2			
1964		2,329.5			
1963	967	2,240.9			2.317
1962		2,078.2			
1961		2,084.0			
1960		2,053.8			
1959		1,897.9			
1958	1,233	1,888.2			1.531

1/ U. S. Industrial Outlook, 1974.

2/ Data for SIC's 2016 and 2017 not available prior to 1972.

Source: 1972 Census of Manufactures.

The 50 percent decline in the number of plants and the four-fold increase in the average shipments per firm by 1972 indicate economies of scale within the industry (Table II-2). The dynamics of the industry also reflect the industry effort to provide more specialized products, particularly in the form of further processed poultry products.

The importance of further processing is shown by the fact that the amount of ready-to-cook turkey which was further processed increased from 8 percent in 1961 to 36 percent in 1972 (9).

Overall, the poultry processing industry has experienced some of the typical patterns which characterize a growth industry. In the early stages of development, there is a proliferation of small firms attracted by favorable profits. As more firms enter the market, competition for sales becomes keen and usually results in price cutting that reduces profits. The small inefficient firms find it difficult to survive. The more efficient and better financed firms absorb some of those that are unable to remain viable. Even though the industry has experienced dramatic changes within the past decade, it appears a high degree of competition will continue to exist in the forseeable future.

B. Distribution of Total Sales Dollar

While total sales increased from $2,936.1 million to $3,874.3 million from 1967 to 1972, the distribution of the sales dollar was altered somewhat. The aggregate distribution of the total sales dollar derived from the Census of Manufactures is summarized below.

Distribution of Sales Dollar

	1967	1972
	------ Percent-----	
Total sales	100.0	100.0
Cost of material	80.33	77.53
Production wages	8.97	10.29
Other operating costs, taxes and profit	10.70	12.18

The number of production employees increased from 77,700 to 85,000 - a 9.4 percent increase--while total wages increased from $263.5 million to $400.0 million-- a 51.8 percent increase. The greater portion of the sales dollar for labor resulted from the fact that annual sales per production worker increased 20.6 percent while annual wages per employee increased 28.9 percent.

The major cost of material consists of poultry meat which, as a percent of sales, decreased over the 1967-1972 time frame. Although total expenditures for materials increased from $2,358.5 million to $2,967.5 million, a 25.8 percent increase, sales during the period increased by 32.0 percent. A more detailed distribution of the sales dollar is shown in Table II-3. Most of the indirect cost as well as profits showed slight increases during the 1967-1972 period.

C. Earnings

Sources for estimating profits in the poultry processing industry are quite limited. Data on 17 firms for 1959-1964 are summarized in Table II-4. However, these data are quite obsolete and unrealistic when the results are compared with the present cost of plant, equipment and capital. A more realistic current estimate is shown in Table II-3 where before tax profits for the industry as a whole ran 2.9 percent of sales in 1972. That profit rate is roughly equivalent to 7.5 percent of total assets and about 20 percent of the book value of depreciable fixed assets. Before tax profits were equal to approximately 25 percent of net worth.

Annual Statement Studies by Robert Morris Associates reports 1972 earnings for a sample of 11 poultry dressing companies financial statements. A range of before tax profits of 2.3 to 19.0 percent of total assets included only 50 percent of the sample--indicating that profits vary quite widely from firm to firm. Annual earnings for the industry as a whole are quite volatile. The cyclical nature of the industry accounts for much of the annual profit variability within the industry. Large profits in one year may be more than offset by losses in the following year, e.g., 1973 and 1974. It appears that more plant closures can be traced to large short-run losses than to chronic unprofitability. In other words, capital availability and liquidity are critical problems for many firms. The imposition of pollution control requirements will tend to accentuate this problem.

Table II-3. Poultry meat processing industry distribution of sales by cost and earnings components, 1967 and 1972.

	1967	1972
Sales	100.0	100.0
Direct Costs		
Raw materials	67.0	61.1
Labor	9.0	10.3
Supplies-containers, parts and other materials	9.5	8.4
Cost of resales	3.1	5.7
Fuels and electricity	0.6	1.1
Other direct costs	0.1	0.3
Total direct	89.3	86.9
Indirect Costs		
Labor	1.8	2.0
Depreciation	0.9	0.9
Interest	0.5	0.8
Rents	0.1	0.1
Taxes	0.5	0.6
Other	4.4	5.8
Total indirect costs	8.2	10.2
Total Costs	97.5	97.1
Profit before tax	2.5	2.9
Income taxes	1.1	1.3
Earnings	1.4	1.6

Source: Estimated by Development Planning & Research Associates, Inc.

Table II-4. Earning rates for 17 chicken-processing firms, 1959-64 1/

Year	Net income after taxes as a percentage of --		
	Sales	Assets	Net worth
1959	0.41	2.3	4.8
1960	.60	2.2	7.5
1961	.69	3.9	8.1
1962	.80	5.3	10.2
1963	.73	4.1	8.3
1964	.66	3.7	7.6
6-year average	0.65	3.6	7.7

1/ All meatpacking firms and firms with less than 50 percent of 1964 sales from meat and poultry were excluded. Firms were classified based on 1964 operations. Excluded were firms processing more than one product; that is, both chickens and turkeys. Many firms were vertically integrated; however, fiscal years were not all on a calendar year basis, although most of these years corresponded approximately.

Source: Organization and Competition in the Poultry and Egg Industries, Natl. Commis. on Food Mktg. Tech. Study no. 2, June 1966.

D. Industry Cash Flow

Based on the distribution of sales data presented in Section B, above, it appears the industry-wide cash flows averaged about 2.3 and 2.5 percent of sales for 1967 and 1972, respectively (cash flow = after tax earnings + depreciation). In absolute terms, the 1972 cash flow for the industry was about $95 million (including egg processing plants). Of that, $60 million was spent for new plants and equipment. Another $5 million was probably expended for used plants and equipment.

E. Ability to Finance New Investment

The ability of a firm to finance new investment for pollution abatement is a function of several critical financial and economic factors. In general terms, new capital must come from one or more of the following sources: (1) funds borrowed from outside sources, (2) equity capital or (3) internally generated funds -- retained earnings and the stream of funds attributed to depreciation of fixed assets.

For each of the three major sources of new investment, the most critical set of factors is the financial condition of the individual firm. For debt financing, the firm's credit rating, earnings record over a period of years, stability of earnings, existing debt-equity ratio and the lenders' confidence in management will be major considerations. New equity funds through the sale of securities will depend upon the firm's future earnings as anticipated by investors, which in turn will reflect past earnings records. The firm's record, compared to others in its own industry and to firms in other similar industries, will be a major determinant of the ease with which new equity capital can be acquired. In the comparisons, the investor will probably look at the trend of earnings for the past five or so years. New equity capital for a sole proprietorship will be available only if the entrepreneur has sufficient cash reserves or has other enterprises which can provide financial resources.

Internally generated funds depend upon the margin of profitability and the cash flow from operations. Also, in publicly held corporations, stockholders must be willing to forego dividends in order to make earnings available for reinvestment.

The condition of the firm's industry and general economic conditions are also major considerations in attracting new capital. The industry will be compared to other similar industries (i.e., other processing industries) in terms of net profits on sales and on net worth, supply-demand relationships, trends in production and consumption, the state of technology, impact of government regulation, foreign trade and other significant variables. Declining or depressed industries are not good prospects for attracting new capital. At the same time, the overall condition of the domestic and international economy can influence capital markets. A firm is more likely to attract new capital during a boom period than during a recession. On the other hand, the cost of new capital will usually be higher during an expansionary period. Furthermore, the money markets play a determining role in new financing. These general guidelines can be applied to the poultry processing industry.

Capital expenditures in the poultry processing industry are compiled on an annual basis. These data are shown in Table II-5. Total industry expenditures have increased from $28.1 million in 1958 to $60.2 million in 1972. While total expenditures have increased over the period, year-to-year changes have been quite erratic. The average expenditure per plant has increased from $22,800 in 1958 to $93,900 in 1972. The increase in per plant expenditures reflects the trend to the much larger and more efficient processing operations. The year-to-year erratic movements undoubtedly are at least partly a function of capital availability. High profit years contribute to capital availability, whereas low profit or loss years restrict the availability of capital. The effect of the cyclical patterns in the industry has been discussed above.

Given the nature of the poultry meat processing industry, it is anticipated that the requisite capital for investment in pollution control facilities will not be available for some establishments. A lot of the small and medium sized firms are rather highly leveraged. Should capital outlays for pollution control coincide with unprofitable operating positions such as we are currently seeing, willing lenders probably could not be found in many cases. This is especially so for the smaller, less-diversified firms in the industry.

It can be observed that the financial market is rather pessimistic in evaluation of some of the firms involved in poultry processing. For example, two firms with sales of $100-200 million in 1973 have a price/earnings ratio between 2 and 3. In addition, they are selling at 50-75 percent of book value. Even the larger conglomerates such as Esmark and Greyhound are selling at 5 and 6 times 1973 earnings.[52/] This situation raises serious doubts as to the availability of capital to these firms for non-productive investment.

Table II-5. Annual expenditures for new plant and equipment in the poultry processing industry, 1958-1972 (SIC-2015 except 1972 when change was made to SIC 2016 and 2017

Year	No. of establishments	Total industry expenditures 1/	Expenditures as a percent of value of shipments	Average expenditures per plant 2/
		($ million)	(Percent)	($000)
1972 3/	641	60.2	1.55	93.9
1971		62.8	1.80	
1970		60.3	1.74	
1969		51.7	1.49	
1968		37.9	1.23	
1967 3/	843	57.2	1.95	67.9
1966		43.6	1.58	
1965		31.9	1.28	
1964		21.3	0.91	
1963 3/	967	34.3	1.42	35.5
1962		19.3	0.91	
1961		19.2	0.92	
1960		23.0	1.12	
1959		24.5	1.29	
1958 3/	1,233	28.1	1.49	22.8

1/ 1971 Annual Survey of Manufactures

2/ Excludes purchases of used plant and equipment

3/ Census of Manufactures

III. MODEL PLANTS

The model plant concept was used to develop definitive financial profiles representative of the different sizes and types of plants in the poultry processing industry. While this approach has certain limitations, it does reflect basic relationships and tendencies for firms within the industry. The model plants do not represent specific firms, and they require a considerable degree of simplification and standardization which includes uniform factor prices and treatment of cost items as well as the limitation of the product lines for individual plants.

A. Type of Plants

In this analysis, we have developed model plants as follows:

Chicken processing
Turkey processing
Duck processing
Fowl processing
Further processing of poultry meat

The first four types are considered as single-product operations, even though many multiple-product plants exist within the industry. The chicken plants are processing broilers that are sold as whole ice-pack birds. Turkey processing in the past has been associated with multiple-product processing plants, but the more recent trend has been to larger specialized operations. The turkey plants are assumed to be processing mature young turkeys which are marketed as bagged whole frozen turkeys.

The duck processing plants are processing only ducks which are also sold bagged, whole and frozen.

The fowl plants are handling fowl exclusively and these are sold as whole ice-pack birds. Further processing has been characterized by proliferation of product lines, and this has necessarily been severely delimited to only three lines. These product lines are: 1. cooked chicken parts; 2. turkey rolls and parts; and 3. canned whole chicken.

B. Sizes of Plants

Sizes of model plants were developed from prior research studies as well as from discussions with personnel from engineering firms, equipment supply firms, and processing firms within the industry.

For a detailed discussion of types and sizes of plants in the industry, the reader is referred to Chapter I of this report.

For this analysis, four sizes of chicken plants are used. The small plant was a 3,000 bird per hour facility with annual input of 21.26 million pounds of live chickens. The medium plant was 6,000 birds per hour with an annual input of 42.25 million pounds. The large size had a capacity of 9,600 birds per hour which gave an annual slaughter of 68 million pounds. The very large size was a plant with a rated capacity of 14,400 birds per hour, and operating at 90% resulted in the processing of 96.68 million pounds annually.

Three sizes of turkey processing plants were used for this analysis. The small plant had a capacity of 900 birds per hour and total pounds processed annually were 16.78 million (live weight). The medium-size plant was rated at 1,800 birds per hour with an annual input of 33.56 million pounds. The large plant capacity was 3,000 birds per hour with 55.94 million pounds of turkey slaughtered annually.

The limited number of duck processing plants (17 plants) vary considerably in both size and utilization. After discussion with industry representatives it was decided to use a capacity of 1,400 birds per hour with annual utilization of 60 percent. This gave an annual input of 10,584,000 pounds (live weight).

Fowl plants also exhibit considerable variation in size and utilization. Most of the fowl plants are older facilities that have undergone extensive modification over the years. For this analysis a fowl plant with 48,000 birds per hour was used and it was considered to be operating at 60 percent of capacity on an annual basis. This resulted in an annual live weight input of 27,072,000 pounds.

Further processing plants have been increasing in size in recent years. The input of 9,870,000 pounds of poultry meat per year seemed to reflect the increased sizes of these plants. The size, as well as utilization, seems to be influenced by the product line or product mix. The input mix by weight for the model plant is assumed to be 57.45 percent for turkey rolls and roasts, and 21.28 percent each for cooked chicken parts and canned whole chickens.

Although the fowl, duck and further processing segments were quite heterogeneous in size, the decision was made to construct only one model plant for each segment. The decision for one plant in each of these segments was based upon the limited number of plants represented as well as limited data time and budget.

C. Investment

The estimated replacement costs, book value and salvage for each model plant in various classifications and size groups are shown in Tables III-1 through III-3. Separate estimates are shown for land, building and facilities, and installed plant and equipment. In addition, current assets, current liabilities and net working capital are shown.

Replacement Values

The plant replacement cost estimates reflect current construction costs of the general design under which the plants would be built today. They reflect improvements in building design as well as technological advances in processing equipment that may not be included in some of the existing plants. In other words, the cost estimates reflect replacing the operational plants the way they would be built today. These costs were based upon estimates provided by industry engineers.

It should be noted that no estimates for mobile equipment are included in the replacement cost estimates. For this analysis, it is assumed that transportation service is a purchased item and appropriate allowances have been made for this service.

Except for holding sheds, building costs which included site development, were estimated at $20.00 per square foot. Economies of scale exist in the building and equipment requirements. However, the larger economies occur when moving from the small to medium-size plants. This relationship can be observed from the building and equipment costs per bird per hour of chicken processing. These costs for the 3,000, 6,000, 9,600, and 14,400 bird per hour capacities are $351, $274, $247, and $201 per bird per hour respectively. A somewhat similar relationship exists for the other types of plants.

Book Value of Investment

The operating year for the model plants was taken as 1972. This was considered to be a "normal" operating year without the severe distortions which occurred in 1973. To achieve an estimate of book value for 1972, the age of the plants were determined through discussions with industry suppliers and operating executives. The original plants for chicken and turkey processing were considered to have been built in 1960. Replacement costs were deflated to 1960 to determine the original costs. Price deflators did not appear to reflect the large increases in current costs, especially for equipment. Industry suppliers and operating executives felt costs had more than doubled since 1960. The original costs were taken at 50 percent of the value of current replacement costs. These costs appeared to be compatible with previous estimates (1).*

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*See reference at end of chapter.

Based upon normal depreciation procedures, i.e., 20 years for buildings and 10 years for equipment, the book value was derived. The exception to this procedure was the consideration given to minimum book value of building and equipment. In common with most food processing plants, poultry processing 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 (USDA) requirements and concurrent stiffening of state inspection have forced many plants to either undergo extensive remodeling or close. Also, plants may add new equipment to keep pace with new technology. As a result, it was estimated that the book value of buildings and machinery and equipment for the model plants would depreciate to 66 percent of original value, then periodic replacements result in the book value remaining at that level. Land was included in book value at the estimated purchase price.

Salvage Value

The salvage value of processing plants will vary widely from plant to plant, depending on the age of plant and its condition, and the age of the equipment and its condition. In some instances the salvage value of old, obsolete plants will be equal to the site value only. If the building is remodeled or refurbished for other uses such as a warehouse, the salvage value may approach 20 percent of its replacement cost.

There is a limited market for used machinery. Virtually all new plants would begin with all new equipment. As a result, with the high cost of dismantling old equipment, used equipment may be purchased at 10 to 30 percent of replacement cost.

Since no data are available on actual salvage values for poultry processing plants and only a very limited market exists for used equipment, it is difficult to estimate the salvage value of a plant closed because of the added costs of pollution abatement. It is assumed the land equals the current market value and the salvage value of buildings and equipment will approximate 20 and 10 percent respectively. All of the net operating capital will be recovered intact. The combined values of land, buildings, equipment and operating capital for each model plant are shown in Tables III-1 through III-3.

Table III- 1. Estimated investment capital for chicken processing plants

	Small			Medium			Large			Very Large		
	3,000 birds/hr.			6,000 birds/hr.			9,600 birds/hr.			14,400 birds/hr.		
	Current	Salvage	Book	Current	Salvage	Book	Current	Salvage	Book	Current	Salvage	Book
	$1,000											
Land	15	15	8	30	30	15	45	45	23	60	60	30
Building	388	78	128	550	110	181	793	159	261	933	187	308
Equipment	653	65	215	1,066	107	352	1,535	153	507	1,905	190	628
Total	1,056	158	351	1,646	247	548	2,373	357	791	2,898	437	966
Current assets	698	698	698	1,395	1,395	1,395	2,231	2,231	2,231	3,172	3,172	3,172
Current liabilities	349	349	349	698	698	698	1,116	1,116	1,116	1,586	1,586	1,586
Net working capital	349	349	349	697	697	697	1,115	1,115	1,115	1,586	1,586	1,586
Total invested capital	1,405	507	700	2,344	946	1,246	3,488	1,473	1,907	4,484	2,023	2,552

Table III- 2. Estimated investment capital for turkey processing plants

	Small			Medium			Large		
	900 birds/hr.			1,800 birds/hr.			3,000 birds/hr.		
	Current	Salvage	Book	Current	Salvage	Book	Current	Salvage	Book
	$1,000								
Land	30	30	15	45	45	23	60	60	30
Building	480	96	158	800	160	264	1,160	232	383
Equipment	1,090	109	360	1,575	158	519	1,963	196	647
Total	1,600	235	533	2,420	363	806	3,183	488	1,060
Current assets	772	772	772	1,543	1,543	1,543	2,572	2,572	2,572
Current liabilities	386	386	386	773	773	773	1,286	1,286	1,286
Net working capital	386	386	386	772	772	772	1,286	1,286	1,286
Total investment capital	1,986	621	919	3,191	1,134	1,577	4,469	1,774	2,346

Table III-3. Estimated investment capital for duck and fowl processing plant

	Duck 1,400 birds/hour			Fowl 4,800 birds/hour			Further processed poultry 56,400 lbs/day		
	Current	Salvage	Book	Current	Salvage	Book	Current	Salvage	Book
	$000								
Land	75	75	38	24	24	12	74	74	37
Building	800	160	264	489	98	162	740	148	244
Equipment	1,225	123	402	930	93	307	1,480	148	488
Total	2,100	358	704	1,443	215	481	2,294	370	769
Current assets	631	631	631	666	666	666	619	619	619
Current liabilities	316	316	316	333	333	333	310	310	310
Net working capital	315	315	315	383	333	333	309	309	309
Total investment capital	2,416	674	1,020	1,776	548	814	2,604	680	1,079

Operating Capital

Current assets, current liabilities and net working capital are also shown in Tables III-1, III-2, & III-3. Current assets were estimated to be 16 percent of sales and conforms to the relationship existing in most food processing industries. Many integrated operations have higher levels of current assets reflecting higher inventory levels necessary in integrated operations. Current liabilities were estimated at 8 percent of sales. This gives a current ratio of 2.0 which is financially sound and comparable to related firms in the food processing industry where there is a relatively high rate of inventory turnover.

D. Model Plant Capacity and Utilization

Annual throughput for each of the model processing plants is summarized in Tables III-4 through III-6 . Utilization of plant capacity varies with the type of product. The most stable utilization rate is for processing chickens where the small, medium and large plants are considered to be operating at 95 percent of capacity, while the very large plant operates at 90 percent of capacity. The chicken plants normally operate on an 8-hour day for 250 days per year. Chickens were considered to give a net yield of 72 percent for whole, ice-packed birds. This made allowance for condemned birds, as well as for moisture pickup.

Turkey processing plants for large turkeys reflect the seasonal growing period. The turkey plants are considered to be operating 140 working days per year at a utilization rate of 90 percent of capacity. The yield of heavy turkeys is 79.4 percent of live weight which allows for condemned birds and moisture pickup. The final product is bagged, frozen, ready-to-cook turkey.

Considerable variation exists in the utilization of capacity for duck and fowl plants. The model plants for this analysis were assumed to be operating at 60 percent of capacity on an annual basis. Industry yields on ducks appeared to range between 69 and 73 percent. Therefore, a yield of 71 percent was taken as the yield for the model duck plant. Yield differentials were somewhat greater on fowl, but a 62 percent yield was used for the model fowl plant.

Table III-4. Input-output of model plants in the chicken processing industry.

Capacity	Small 3000 BPH	Medium 6000 BPH	Large 9600 BPH	Very Large 14,000 BPH
Raw Product				
Birds/Hour	2,850	5,700	9,120	12,960
Birds/Day	22,800	45,600	72,960	103,680
Birds/Year	5,700,000	11,400,000	18,240,000	25,920,000
Lbs. live wt./Hour	10,630	21,260	34,000	48,340
Lbs. live wt./Day	85,040	170,080	272,000	386,720
Lbs. live wt./Year	21,260,000	42,520,000	68,000,000	96,680,000
Finished Product				
Lbs./Hour	7,654	15,307	24,480	34,805
Lbs./Day	61,232	122,456	195,840	278,440
Lbs./Year	15,308,000	30,614,000	48,960,000	69,610,000

Hours/Day - 8
Days/Year - 250

Average live weight/bird - 3.73 lbs.
Yield of RTC with moisture pickup, less condemned = 72%

Lbs. offal/year (28%)	5,952,800 (small)	11,905,600 (medium)	19,040,000 (large)	27,070,400 (very large)

Table III-5. Input-output of model plants in the turkey processing industry.

Capacity	Small 900 BPH	Medium 1800 BPH	Large 3000 BPH
Raw Product			
Birds/Hour	810	1,620	2,700
Birds/Day	6,480	12,960	21,600
Birds/Year	907,000	1,814,000	3,024,000
Lbs. live wt./Hour	14,985	29,970	49,950
Lbs. live wt./Day	119,880	239,760	399,600
Lbs. live wt./Year	16,783,000	33,566,000	55,944,000
Finished Product			
Lbs./Hour	11,898	23,796	39,660
Lbs./Day	95,185	190,369	317,282
Lbs./Year	13,326,000	26,652,000	44,420,000

Hours/day - 8
Days/year - 140
Number of birds reflects heavy hens and toms processed at the rate of 4 hens to 3 toms.
Average weight live = 18.5 lbs.
Yield of frozen whole birds with moisture pickup = 82.2% less 2.8% condemned = 79.4% net
Utilization of capacity = 90% for the number of days per year

Table III-6. Input-output of model plants in the duck, fowl, and further processing industries

	Ducks	Fowl		Further Processing
Capacity	1,400	4,800	Raw product capacity lbs/day	56,400
Birds/hour	840	2,880	Lbs poultry input/hr	4,935
Birds/day	6,720	23,040	Lbs poultry input/day	39,480
Birds/year	1,680,000	5,760,000	Lbs poultry input/year	9,870,000
Lbs live wt/hr	5,290	13,536		
Lbs. live wt/day	42,336	108,288		
Lbs live wt/year	10,584,000	27,072,000		
Finished Product			Finished Product	
Lbs/hr	3,757	8,392	Lbs/hr	3,625
Lbs/day	30,059	67,139	Lbs/day	28,996
Lbs/year	7,515,000	16,785,000	Lbs/year	7,249,000
Hours	8	8		8
Days/year	250	250		250
Utilization of cap.	60%	60%		70%
Ave. live wt/bird	6.31	4.7	Product mix	
Yield of RTC with moisture			Turkey rolls and roast	57.45%
pick up losses condemned	71%	62%	Cooked chicken pts	21.28%
			Canned chicken	21.28%

Further processing of poultry meat exhibits by far the greatest variability in product line as well as size and utilization of capacity. The extensive study by Rogers and Smith was relied upon rather heavily in developing the model plant for further processing (10). The raw product-finished product relationships for the three product lines were taken directly from the above source. The product mix input of poultry meat consisted of 57.45 percent for turkey rolls and roasts and 21.28 percent each for cooked chicken parts and canned chicken. The further processing plant was assumed to be operating at 70 percent of capacity.

E. Annual Profits

After-tax income, return on sales, both pre-tax and after-tax, and return on invested capital both pre-tax and after-tax, for various types and sizes of plants are shown in Table III-7.

It should be noted that the model plant profiles were based on average 1972 conditions and no published sources of empirical performance data are available. These data for actual plants in the industry are propietary in nature and therefore confidential. Also most of the actual plants would not reflect all of the assumptions made in regard to the limited product lines and average factor prices and relationships. However, industry executives reviewed the models and felt they were representative of these types of plants. The year 1972 was considered a "normal" year in the industry. Profits in 1973 were much higher, but 1974 profits appear to be much lower for the first 5 months.

Profit margins vary considerably between types of plants. Turkey plants are more profitable than chicken plants. Further processing plants appear to be the most profitable of all the plants. The reason for this is the tendency toward a more differentiated product resulting in a more orderly matching of supply and demand.

Generally, industries with widely fluctuating profit margins must maintain a higher average return on investment than those with a higher degree of stability. The ROI must reflect an adequate margin for risk and uncertainty if sufficient capital is to be supplied to maintain modern efficient facilities. The actual profit levels as a percent of sales and invested capital are higher for the larger plants. This is consistent with the tendency to larger and more specialized operations, and presents a tight profit situation for the small plants.

Table III-7. Net income, returns on sales and returns on total invested capital for model plants

Type and size of plant	After-tax income ($000)	Pre-tax return on sales (percent)	After-tax return on sales (Percent)	Pre-tax* ROI (Percent)	After-tax* ROI (Percent)
Chicken					
Small	48	1.74	1.06	10.86	6.57
Medium	112	2.32	1.29	16.18	8.99
Large	184	2.45	1.32	17.93	9.65
Very large	278	2.63	1.40	20.45	10.89
Turkey					
Small	60	2.14	1.24	11.21	6.53
Medium	160	3.04	1.66	18.58	10.08
Large	309	3.62	1.92	24.81	13.17
Duck					
Medium	93	4.21	2.36	16.25	9.12
Fowl					
Medium	74	3.12	1.78	15.97	9.09
Further Processing					
Medium	128	6.03	3.31	21.59	11.86

* Return on total invested capital calculated by financial statement method.

F. Annual Cash Flows

Estimated annual cash flows for the types and sizes of plants analyzed in this study are shown in Table III-8. Cash flow as calculated is the sum of after-tax income plus depreciation. It is shown in absolute dollars as well as a percent of sales and as a percent of total invested capital.

Annual cash flows differ somewhat from the patterns established by annual profits. Even though the absolute level of cash flow increases from the small to the larger chicken plants, when expressed as a percent of sales the order is reversed. This pattern results from the fact that economies of scale are not large, the tax rate is less in the smaller plants, and depreciation is greater per sales dollar reflecting the higher investment costs per bird processed. The latter factor becomes of lesser importance when cash flow is considered as a percent of invested capital. Thus, it can be seen that only small differences exist in the chicken plants based upon this comparison. Cash flow for turkey plants generally follow the same pattern as profits but are more tightly grouped for the reasons given above. However, greater economies of scale exist than for the chicken plants and the larger after-tax profits offset the factors discussed above.

Cash flows for duck and further processing are the highest when considered as a percent of sales. However, this relationship is tempered considerably when cash flow is related to ROI.

G. Cost Structure of Model Plants

The cost structure for the model plants are summarized in Tables III-9 through III-13.

Raw Product Costs

Raw product inputs for the first four types of plants consist of live birds plus assembly costs. Some problem exists in the determination of live farm prices of chickens since the industry is almost wholly integrated. However, average U.S. farm prices of live chickens are given in Poultry and Egg Situation, and the price of 14.1 cents per pound for 1972 was taken from this source. A more detailed discussion of pricing follows in Chapter IV. A net yield of 72 percent ready-to-cook ice pack gave a cost of 19.55 cents per eviscerated pound. The 72 percent yield allows

Table III-8. Annual cash flow for model poultry processing plants

Type and size of plant	Annual cash flow	Cash flow as percent of sales	Cash flow as percent total invested capital
	($000)	(percent)	(percent)
Chicken			
Small	89	2.04	12.71
Medium	179	2.05	14.37
Large	281	2.02	14.71
Very large	397	2.00	15.56
Turkey			
Small	127	2.63	13.82
Medium	259	2.69	16.42
Large	436	2.71	18.58
Duck			
Medium	174	4.41	17.06
Fowl			
Medium	133	3.19	16.34
Further processing			
Medium	221	5.71	20.48

Table III- 9. Pro forma income statements for chicken processing model plants

	Small			Medium		
Birds/hr. capacity	3,000			6,000		
Annual lbs live bird input	21,260,000			42,520,000		
Annual output ice pack	15,308,000			30,614,000		
	Percent	Annual ($000)	¢/lb RTC*	Percent	Annual ($000)	¢/lb RTC
Sales		4,360	28.48		8,718	28.48
Raw material cost						
Poultry	68.65	2,993	19.55	68.65	5,985	19.55
Non-Poultry	4.56	199	1.30	4.57	398	1.30
Total	73.21	3,192	20.85	73.22	6,383	20.85
Direct cost						
Labor	10.64	464	3.03	10.53	918	3.00
Supplies and containers	1.74	76	0.50	1.76	153	0.50
Utilities	1.06	46	0.30	1.06	92	0.30
Total	13.44	586	3.85	13.34	1,163	3.80
Indirect cost						
Repairs & Maintenance	0.78	34	0.22	0.77	67	0.22
Taxes & insurance	0.71	31	0.20	0.70	61	0.20
General & admin.	8.67	378	2.47	8.40	732	2.39
Total	10.16	443	2.89	9.87	860	2.81
Total expense	96.79	4,220	27.57	96.42	8,406	27.46
Interest	0.48	21	0.14	0.49	43	0.14
Depreciation	0.96	42	0.27	0.77	67	0.22
Total cost	98.26	4,284	27.98	97.68	8,516	27.82
Net income B.T.	1.74	76	0.50	2.32	202	0.66
Income tax	0.69	30	0.19	1.03	90	0.29
Net income A.T.	1.06	48	0.31	1.29	112	0.37
Cash flow	2.04	89		2.05	179	
Total invested capital		700			1,246	
R.O.I. before taxes	10.86			16.18		
R.O.I. after taxes	6.57			8.99		

* Ready-to-cook

Table III-9. Pro forma income statements for chicken processing model plants (continued)

	Large			Very Large		
Birds/hr. capacity	9,600			14,400		
Annual lbs live bird input	68,000,000			96,680,000		
Annual output ice pack	48,960,000			69,610,000		
	Percent	Annual ($000)	¢/lb RTC	Percent	Annual ($000)	¢/lb RTC
Sales		13,944	28.48		19,825	28.48
Raw material cost						
Poultry	68.64	9,571	19.55	68.64	13,608	19.55
Non-Poultry	4.56	636	1.30	4.56	905	1.30
Total	73.20	10,207	20.85	73.21	14,513	20.85
Direct cost						
Labor	10.53	1,469	3.00	10.53	2,088	3.00
Supplies and containers	1.76	245	0.50	1.76	348	0.50
Utilities	1.05	147	0.30	1.05	209	0.30
Total	13.34	1,860	3.80	13.34	2,645	3.80
Indirect cost						
Repairs & Maintenance	0.77	108	0.22	0.77	153	0.22
Taxes & insurance	0.70	98	0.20	0.69	137	0.20
General & admin.	8.32	1,160	2.37	8.25	1,636	2.35
Total	9.80	1,366	2.79	9.73	1,928	2.77
Total expense	96.35	13,435	27.44	96.28	19,087	27.42
Interest	0.50	69	0.14	0.49	97	0.14
Depreciation	0.70	98	0.20	0.60	119	0.17
Total cost	97.54	13,601	27.78	97.37	19,303	27.73
Net income B.T.	2.45	342	0.70	2.63	522	0.75
Income tax	1.13	158	0.32	1.23	244	0.35
Net income A.T.	1.32	184	0.38	1.40	278	0.40
Cash flow	2.02	281		2.00	397	
Total invested capital		1,907			2,552	
R.O.I. before taxes	17.93			20.45		
R.O.I. after taxes	9.65			10.89		

Table III- 10. Pro forma income statements for turkey processing model plants

	Small			Medium		
Birds/hr. capacity	900			1,800		
Annual lbs live bird input	16,783,000			33,566,000		
Annual output frozen RTC	13,326,000			26,652,000		
	Percent	Annual ($000)	¢/lb RTC	Percent	Annual ($000)	¢/lb RTC
Sales		4,823	36.19		9,645	36.19
Raw material cost						
Poultry	77.25	3,726	27.96	77.26	7,452	27.96
Non-Poultry	2.76	133	1.00	2.77	267	1.00
Total	80.01	3,859	28.96	80.03	7,719	28.96
Direct cost						
Labor	5.58	269	2.02	5.53	533	2.00
Supplies and containers	5.39	260	1.95	5.25	506	1.90
Utilities	1.66	80	0.60	1.66	160	0.60
Total	12.63	609	4.57	12.43	1,199	4.50
Indirect cost						
Repairs & Maintenance	0.60	29	0.22	0.61	59	0.22
Taxes & insurance	0.50	24	0.18	0.50	48	0.18
General & admin.	2.32	112	0.84	1.96	189	0.71
Total	3.42	165	1.24	3.07	296	1.11
Total expense	96.14	4,637	34.77	95.53	9,214	34.57
Interest	0.41	20	0.15	0.41	40	0.15
Depreciation	1.39	67	0.50	1.03	99	0.37
Total cost	97.95	4,720	35.42	96.96	9,352	35.09
Net income B.T.	2.14	103	0.77	3.04	293	1.10
Income tax	0.89	43	0.32	1.38	133	0.50
Net income A.T.	1.24	60	0.45	1.66	160	0.60
Cash flow	2.63	127		2.69	259	
Total invested capital	19.05	919			1,577	
R.O.I. before taxes	11.21			18.58		
R.O.I. after taxes	6.53			10.08		

Table III- 10. Pro forma income statements for turkey processing model plants (continued)

	Large		
Birds/hr. capacity	3,000		
Annual lbs live bird input	55,944,000		
Annual output frozen RTC	44,420,000		
	Percent	Annual ($000)	¢/lb RTC
Sales		16,076	36.19
Raw material cost			
Poultry	77.26	12,420	27.96
Non-Poultry	2.76	444	1.00
Total	80.02	12,864	28.96
Direct cost			
Labor	5.52	888	2.00
Supplies and containers	5.19	835	1.88
Utilities	1.65	266	0.60
Total	12.38	1,990	4.48
Indirect cost			
Repairs & Maintenance	0.61	98	0.22
Taxes & insurance	0.50	80	0.18
General & admin.	1.66	444	0.60
Total	2.76	444	1.00
Total expense	95.16	15,298	34.44
Interest	0.42	67	0.15
Depreciation	0.79	127	0.29
Total cost	96.37	15,493	34.88
Net income B.T.	3.62	582	1.31
Income tax	1.70	273	0.61
Net income A.T.	1.92	309	0.70
Cash flow	2.71	436	
Total invested capital	14.59	2,346	
R.O.I. before taxes	24.81		
R.O.I. after taxes	13.17		

Table III- 11. Pro forma income statement for duck processing

	Medium
Birds/hr. capacity	1,400
Annual lbs live bird input	10,584,000
Annual output frozen RTC	7,515,000

	Percent	Annual ($000)	¢/lb RTC
Sales	100.00	3,945	52.50
Raw material cost			
Poultry	66.23	2,593	34.50
Non-Poultry	1.90	75	1.00
Total	67.63	2,668	35.50
Direct cost			
Labor	11.09	437	5.82
Supplies and containers	7.43	293	3.90
Utilities	1.14	45	0.60
Total	19.66	775	10.32
Indirect cost			
Repairs & Maintenance	0.99	39	0.52
Taxes & insurance	0.67	26	0.35
General & admin.	3.81	150	2.00
Total	5.47	215	2.87
Total expense	92.76	3,658	48.96
Interest	0.99	39	0.52
Depreciation	2.05	81	1.08
Total cost	95.80	3,778	50.29
Net income B. T.	4.21	166	2.21
Income tax		73	1.00
Net income A. T.	2.36	93	1.21
Cash flow	4.41	174	2.32
Total invested capital		1,020	
R.O.I. before taxes	16.25		
R.O.I. after taxes	9.12		

Table III- 12. Pro forma income statements for fowl processing

	Medium		
Birds/hr. capacity	4,800		
Annual lbs live bird input	27,072,000		
Annual output ice pack	16,785,000		
	Percent	Annual ($000)	¢/lb RTC
Sales		4,163	24.80
Raw material cost			
Poultry	57.87	2,409	14.35
Non-Poultry	8.07	336	2.00
Total	65.94	2,745	16.35
Direct cost			
Labor	17.13	713	4.25
Supplies and containers	1.42	59	0.35
Utilities	1.61	67	0.40
Total	20.15	839	5.00
Indirect cost			
Repairs & Maintenance	0.50	21	0.13
Taxes & insurance	0.34	14	0.08
General & admin.	7.95	331	1.97
Total	8.79	366	2.18
Total expense	94.86	3,949	23.53
Interest	0.60	25	0.15
Depreciation	1.42	59	0.35
Total cost	96.88	4,033	24.03
Net income B. T.	3.12	130	0.77
Income tax	1.35	56	0.33
Net income A. T.	1.78	74	0.44
Cash flow	3.19	133	0.79
Total invested capital		814	
R.O.I. before taxes	15.97		
R.O.I. after taxes	9.09		

Table III- 13. Pro forma income statements for further processing

	Medium
Pounds/day input	56,400
Annual lbs poultry meat (70% cap)	9,870,000
Annual output finished product	7,249,000

	Percent	Annual ($000)	¢/lb RTC
Sales	100.00	3,869	53.37
Raw material cost			
Poultry	60.79	2,352	32.45
Non-Poultry	1.50	58	0.80
Total	62.29	2,410	33.25
Direct cost			
Labor	5.58	216	2.98
Supplies and containers	7.91	306	4.22
Utilities	1.65	64	0.88
Total	15.14	586	8.08
Indirect cost			
Repairs & Maintenance	1.03	40	0.55
Taxes & insurance	0.75	29	0.40
General & admin.	11.58	448	6.18
Total	13.36	507	7.13
Total expense	90.54	3,503	48.32
Interest	1.03	40	0.55
Depreciation	2.40	93	1.28
Total cost	93.97	3,636	50.16
Net income B. T.	6.03	233	3.21
Income tax	2.72	105	1.45
Net income A. T.	3.31	128	1.76
Cash flow		221	
Total invested capital		1,079	
R.O.I. before taxes	21.59		
R.O.I. after taxes	11.86		

for condemned birds and moisture pickup. It was assumed that 90 percent of the blood, feathers and offal was recovered and sold to renderers. Assembly costs were estimated to be 1.3 cents per eviscerated pound. On the above basis, raw material costs accounted for 74.0 percent of the sales dollar. This compares favorably with 1972 census data which had 77.5 percent for material costs which also included supplies, containers and energy.

The farm price of live turkeys for 1972 was taken from Poultry and Egg Situation and was 22.2 cents per pound. The turkey industry operates at a lower level of integration than does the broiler industry. Therefore, even though this is an average price, it is felt this represents a valid cost figure. The average yield for heavy turkeys with moisture pickup was taken as 82.2 percent, and after deducting 2.8 percent for condemned birds resulted in a net yield of 79.4 percent. The above cost and yield when converted to bagged, frozen, ready-to-cook form gave a per pound cost of 27.96 cents. Assembly costs were one cent per pound (RTC basis). The total of 28.96 cents per pound represented 80.45 percent of the sales dollar for raw material costs. It should be noted that sales of turkeys were assumed to be f.o.b. plant and did not allow for delivery to the central markets.

Published national average farm prices of ducks are not available. It was necessary to contact industry representatives to obtain estimates of 1972 live duck prices f.o.b. plant. These estimates approximated 24.5 cents per pound. Considering a 71 percent yield, this resulted in a raw product cost of 34.5 cents per eviscerated pound and represented 66.23 percent of the sales dollar. By-product sales for ducks include not only offal but also feathers and feet and these items make a significant contribution to sales.

Fowl prices are characterized by wide variations and fluctuations. The farm price of 8.9 cents per pound was taken from Poultry and Egg Statistics through 1972. Two cents per pound were allowed for assembly costs. A 62 percent yield gave a raw product cost of 16.35 cents per eviscerated pound for fowl which represented 66.25 percent of the sales dollar.

Operating Costs

Derivation of both direct and indirect costs was based upon a synthesis from several sources. These sources included industry operating executives, census data and previous research studies (1, 2, 4, 5, 6, 7, 8, 9 and 10).

a. Direct Costs

Direct costs included labor, supplies, containers and utilities. As a percent of the sales dollar, total direct costs ranged from a low of 12.38 percent for large turkey plants to a high of 20.26 percent for fowl processing. The greatest variation was reflected in labor costs with the large turkey plant low at 5.52 percent and the fowl plant high at 17.22 percent.

The cost of supplies and containers were to a large degree a function of the form of the finished product. Ice-packed birds (chickens and fowl) had the lowest cost, whereas further processed poultry had the highest cost for supplies and containers.

The utility cost for all plants was less than two percent. Those plants with higher utility costs were those handling frozen poultry. It is well to note that a great deal of concern was expressed over the major increases that have taken place and are expected to take place in the future in regard to utility costs.

b. Indirect costs

Indirect costs included repairs and maintenance; taxes and insurance; and general and administrative expenses. Total indirect costs varied from a low of 2.76 percent of sales for the large turkey plant to a high of 13.36 percent for the further processing plant. The major variant of indirect costs was in the sector of general and administrative expense. The large turkey plant had 1.66 percent of sales for this category compared to 8.32 percent for the large chicken plant. However, approximately three-fourths of the large chicken plant percentage represented transportation costs to the central market. The turkey plant sales were assumed to be f.o.b. plant. Further processing had the largest percentage cost for general and administrative expense. A large portion of this is accounted for by the differences in marketing which involves considerable advertising and greater sales effort.

Non-operating Costs

Non-operating costs included interest and depreciation. Interest charges as a percent of sales varied from 0.41 percent for turkeys to a high of 1.03 percent for further processing. Depreciation was somewhat higher than interest but followed the same general pattern with further processing being the highest at 2.40 percent of sales. Both interest and depreciation were affected by level of investment and degree of utilization of capacity.

Summary

Overall, the poultry processing industry appears to be relatively efficient. Economies of scale in chicken processing are relatively small, particularly after reaching a level of 6,000 birds per hour. The major economies that do exist are mainly attributed to lower investment costs per unit and lower administrative overhead per unit. Somewhat the same pattern holds for the other types of poultry processing. The operating margins are extremely small, especially when considered on a unit basis. This makes what seemingly are minor changes in costs or prices have a major impact on profits.

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IV. PRICE PATTERNS

A. Pricing Processes

It appears that wholesale prices are strongly influenced by formula pricing. During the 1950's and early 1960's, wholesale prices were generally calculated on the basis of the current live price. However, increasing vertical integration in the industry eliminated the availability and dependability of live prices--especially for broilers. It appears that processors have now turned to published wholesale and retail price averages for the basis of formula pricing. However, formula prices can only serve as a guide. The individual firm must evaluate the economic conditions being encountered and respond accordingly.

Considerable price variation and adjustment takes place on a daily and weekly basis. The extent of weekly variations in broiler prices for 1965 through 1971 is shown in Table IV-1. These fluctuations are a function of supply and demand and provide the mechanism for an orderly market.

Prices paid for raw product are also generally determined on a formula basis. If the supply is from company farms, the price for live birds is essentially a transfer cost from one corporate division to another. A similar situation exists for birds grown under contract. In the case of a cooperative supplying the raw product, the processor may sell its processing services to the growers and never take title to the product. The above pricing situations cover most of the poultry meat processed. For the remaining portion, live prices are probably heavily influenced by transfer prices.

B. Historic Prices

Historic farm, wholesale and retail prices for broilers and turkeys appear in Tables IV-2 and IV-3. Prices and price spreads for selected locations appear in Tables IV-4 and IV-5. Similar data for fowl and ducks are not available. However, farm prices of lightweight Central California and heavyweight Southern hens (Alabama, Georgia, Mississippi and Tennessee) are published and reported at 5.61 and 15.09 cents per pound respectively for 1972. The Agriculture Marketing Service, U.S.D.A., publishes New York Grade A, RTC duckling prices which were reported at 51.32, 49.97 and 72.06 cents per ound in 1971, 1972 and 1973 respectively.

Table IV-1. Weekly average 9-city broiler prices (1965-71)

	Highest weekly price	Percent Fluctuation	Price during the week following the annual high	Percent decrease	Lowest weekly price
1965	29.6	23.7	28.6	(3.6)	23.9
1966	32.2	50.4	29.3	(9.6)	21.4
1967	28.9	35.0	26.8	(7.9)	21.4
1968	31.2	26.9	28.9	(8.1)	24.6
1969	35.5	43.5	35.3	(0.5)	24.7
1970	29.5	34.1	28.1	(5.0)	22.0
1971	32.2	37.7	30.6	(5.3)	23.4
Average		35.9		5.7	

Source: National Broiler Council

Table IV-2. Broiler prices, 1964-1973.

Year	Farm, liveweight per pound, (cents)	Wholesale average of 9 cities, ready-to-cook, per pound (cents)	Frying chicken in retail stores in urban areas ready-to-cook, per pound (cents)
1964	14.2	25.37	37.8
1965	15.0	26.44	39.0
1966	15.3	27.64	41.3
1967	13.3	25.15	38.1
1968	14.2	27.15	39.8
1969	15.2	29.06	42.2
1970	13.5	26.42	40.8
1971	13.8	27.16	41.0
1972	14.3	28.14	41.4
1973	24.3	42.17	59.6

Source: USDA, Poultry and Egg Statistics, and Poultry and Egg Situation (various issues).

Table IV-3. Turkey prices, 1964-1973.

Year	Farm, liveweight per pound, (cents)	New York wholesale, frozen, ready-to-cook, per pound (cents)*	Prices in retail stores, ready-to cook, per pound (cents)
1964	21.0	33.18	46.7
1965	22.0	35.54	48.4
1966	23.1	37.31	50.6
1967	19.6	32.36	48.8
1968	20.5	31.52	46.4
1969	22.4	34.89	48.8
1970	22.6	38.89	55.9
1971	22.1	35.69	54.6
1972	22.2	35.84	55.3
1973	34.3	57.65	73.5

* Average for 8-16 pound young hens and 14-20 pound young toms.

Source: USDA Poultry and Egg Statistics: Poultry and Egg Situation, (various issues)

Table IV-4. Average October-December prices and price spreads for ready to cook medium turkeys, 1966-70 and 1971

City	Prices				Price Spreads			1971 Prices				1971 Price Spreads		
		To city to							To city to					
	Farm	Receiver	Retailer	Retail	I	II	III	Farm	Receiver	Retailer	Retail	I	II	III
Boston	29.0	36.7	38.5	51.6	7.7	1.8	13.2	29.8	39.1	42.1	57.2	9.3	3.0	15.1
New York	28.9	39.5	40.8	54.8	10.8	1.3	14.0	29.8	39.1	42.1	61.0	9.3	3.0	19.0
Baltimore	29.0	37.5	41.0	51.7	8.5	3.5	10.7	29.5	38.4	40.9	58.6	8.9	2.5	17.7
Washington	28.9	38.3	41.7	53.6	9.4	3.4	11.9	30.0	38.4	42.6	58.1	8.4	4.3	15.5
Atlanta	29.0	38.3	42.6	49.0	9.4	4.3	6.4	29.9	39.3	44.0	52.4	9.4	4.7	8.4
Cleveland	29.3	37.1	40.3	52.4	7.8	3.3	12.1	28.9	37.6	41.5	58.1	8.8	3.9	16.6
Chicago	28.8	37.9	41.9	49.0	9.1	3.9	7.1	29.8	37.8	42.3	56.0	7.9	4.5	13.7
St. Louis	28.8	37.3	41.9	48.6	8.4	4.7	6.7	28.4	N.A.	45.5	52.9	N.A.	N.A.	17.1
Denver	28.8	37.0	38.7	48.6	8.2	1.7	9.8	30.0	39.0	40.8	53.1	9.0	1.8	12.3
Los Angeles	N.A.	37.0	39.5	49.4	N.A.	2.5	9.9	31.4	38.1	41.3	53.7	6.7	3.2	12.4
San Francisco	N.A.	38.1	43.5	50.1	N.A.	5.4	6.7	31.6	36.0	44.5	55.1	4.4	8.5	10.6
Ave. 8 cities */	29.0	37.8	40.7	51.3	8.8	2.9	10.6	29.7	38.6	42.0	56.8	8.9	3.4	14.8

*/ Excludes Los Angeles, San Francisco and St. Louis.

Source: Prices and Price Spreads for Eggs, Frying Chickens, and Turkeys in 12 Major Cities, 1966-71, Statistical Bulletin No. 524, Economic Research Service, U. S. Department of Agriculture, August, 1973. Also Development Planning and Research Associates, Inc.

Table IV-5. Average annual prices and price spreads for ready to cook frying chickens, 1966-70 and 1971

City	1966-70 Prices. To city to				1966-70 Price Spreads			1971 Prices To city to				1971 Price Spreads		
	Farm	Re-ceiver	Re-tailer	Retail	I	II	III	Farm	Re-ceiver	Re-tailer	Retail	I	II	III
	cents per pound													
Boston	20.7	27.4	29.7	45.2	6.7	2.3	15.5	19.1	27.8	30.1	48.5	8.7	2.3	18.4
New York	19.8	27.4	29.9	44.4	7.6	2.5	14.5	18.8	27.4	30.3	46.7	8.6	2.9	16.4
Baltimore	18.6	27.1	29.5	40.4	8.5	2.4	10.9	18.8	27.1	30.0	41.8	8.3	2.9	11.8
Washington	19.2	27.9	31.1	38.6	8.7	3.2	7.5	18.6	28.1	31.5	36.3	9.5	3.4	4.8
Atlanta	18.1	25.6	28.0	39.2	7.5	2.4	11.2	17.8	25.7	27.7	39.1	7.9	2.0	11.4
Cleveland	18.7	26.7	29.4	40.0	8.0	2.7	10.6	18.4	26.8	30.6	41.1	8.4	3.8	10.5
Chicago	18.3	26.7	29.9	39.0	8.4	3.2	9.1	18.2	26.7	30.1	40.5	8.5	3.4	10.1
St. Louis	18.3	26.4	29.6	41.4	8.1	3.2	11.8	18.1	26.5	30.5	41.0	8.4	4.0	10.5
Denver	18.7	27.2	29.2	35.7	8.5	2.0	6.5	18.5	27.4	29.4	31.3	8.9	2.0	1.9
Los Angeles	20.1	27.6	31.3	39.2	7.5	3.7	7.9	19.7	27.8	32.8	39.0	8.1	5.0	6.2
San Francisco	19.8	28.0	34.6	45.1	8.2	6.6	10.5	19.2	28.1	35.5	46.3	8.9	7.4	10.8
11 major cities	19.1	27.1	30.2	40.7	8.0	3.1	10.5	18.7	27.2	30.8	41.1	8.5	3.6	10.3

Source: Prices and Price Spreads for Eggs, Frying Chickens, and Turkeys in 12 Major Cities, 1966-71, Statistical Bulletin No. 524, Economic Research Service, U. S. Department of Agriculture, August, 1973. Also Development Planning and Research Associates, Inc.

With the exception of 1973, average annual live poultry prices have held at fairly stable levels. The stability of annual average prices can be related to relatively stable feed prices up to 1973. Also, increases in productivity of growing birds have been offset by increases in non-feed costs. Competition within the industry has left profit margins very low. Major changes in feed prices in 1973 and 1974 have created considerable disorder in the poultry industry. However, the increase in price of broilers was greater than the increase in the price of feed for 1973 which enabled most firms to generate rather high levels of profits. On the other hand, in the first half of 1974 the price of broilers declined to a considerably greater degree than the price of feed which has created a chaotic situation with enormous losses.

The historic relationship between feed costs and the wholesale prices of broilers is summarized in Tables IV-6 and IV-7. It can be seen that a close long run relationship exists between feed prices and wholesale prices of broilers. However, due to the time dimension of supply and demand responses, wholesale price movements tend to lag behind short run movements in feed prices. It must be remembered that most of the broiler operations are highly integrated and any lags in the changes reflecting higher costs can be disastrous for an under-financed firm. Of course, the corollary is the fact that larger firms with better access to capital, and possible economies of scale, can better sustain themselves during the periods of profit stress.

It is difficult to quantitatively assess the various elasticities affecting poultry meat consumption. Although price elasticity estimates for fowl and ducks are not readily available, such estimates for chicken and turkey abound in the literature. Unfortunately, there is a great deal less consistency in the estimates than is desirable. Probably the most comprehensive elasticity study of recent vintage is one completed in 1971 by George and King. Their direct and cross-price elasticities at the retail level for meats appear in Table IV-8. The direct measures appear where the row and column for the same commodity intersect. The cross measure is interpreted as the impact the price of the column commodity has on the row commodity. For example, a 1.0 percent increase in the price of pork induces a 0.12 percent increase in chicken consumption.

A 1970 study by O'Mara derived a wholesale price elasticiy for broilers of 1.053. George and King's estimates of price elasticity at the farm level appear in Table IV-9. Another measure of interest is the elasticity or price transmission -- the percentage change in retail price resulting from a 1 percent change in farm price. This value is estimated at 0.775 for chicken (Table IV-10).

Income elasticities for chicken and turkey were estimated at 0.178 and 0.768 respectively by George and King.

Table IV-6. Average monthly price indices (1964-71) 9-city broilers, #2 yellow corn Chicago, 44% soybean Decatur (annual average price = 100)

	USDA 9-city Broiler price index	#2 Corn price index	44% Soymeal
Jan.	99.4	100.7	100.0
Feb.	103.4	100.6	98.7
Mar.	103.7	101.1	95.4
April	100.2	101.2	95.8
May	102.4	103.2	97.0
June	103.8	103.5	103.5
July	105.6	102.0	107.1
Aug.	101.8	99.5	106.2
Sept.	99.5	98.4	104.1
Oct.	94.6	95.9	97.2
Nov.	94.9	94.2	95.3
Dec.	91.5	99.6	99.7

Source: National Broiler Council

Table IV-7. Increased corn and soybean meal cost per pound of ready-to-cook broilers

	Nov. '72 vs. '71	Dec. '72 vs. '71	Jan. '73 vs. '72
Soybean meal	2.44¢	3.25¢	3.49¢
Corn	.91	1.22	1.26
Total	3.35¢	4.47¢	4.75¢
Increase in wholesale price of broilers	2.87¢	4.02¢	5.7¢
Price difference minus cost difference	-.48¢	-.45¢	+.95¢

Source: National Broiler Council

Table IV-8. Direct and cross price elasticity estimates at the retail level

Commodity	Chicken	Turkey	Beef	Veal	Pork	Lamb and Mutton
Chicken	-0.777	0.084	0.197	0.044	0.121	0.055
Turkey	0.400	-1.555	0.098	0.015	0.065	0.018
Beef	0.068	0.008	-0.644	0.028	0.083	0.045
Veal	0.174	0.014	0.359	-1.718	0.198	0.066
Pork	0.035	0.005	0.076	0.014	-0.413	0.060
Lamb and Mutton	0.234	0.015	0.589	0.066	0.891	-2.626

Source: George, P. S. and G. A. King, Consumer Demand for Food Commodities in the United States with Projections for 1980. Giannini Foundation Monograph Number 26, University of California, Davis, March, 1971.

Table IV-9. Direct and cross price elasticity estimates at the farm level

Commodity	Chicken	Turkey*	Beef	Veal*	Pork	Lamb & Mutton
Chicken	-0.602	x	0.127	x	0.070	0.034
Turkey	0.310	x	0.063	x	0.038	0.011
Beef	0.052	x	-0.416	x	0.048	0.029
Veal	0.134	x	0.032	x	0.115	0.042
Pork	0.027	x	0.049	x	-0.241	0.038
Lamb & Mutton	0.181	x	0.381	x	0.520	-1.670

* Estimates for the turkey and veal columns are not available.

Source: George, P. S. and G. A. King, Consumer Demand for Food Commodities in the United States with Projections for 1980, Giannini Foundation Monograph Number 26, University of California, Davis, March, 1971.

Table IV-10. Elasticity of price transmission, expressing the percentage change in retail price resulting from a 1 percent change in farm price.

Commodity	Elasticity
Meats	
Beef	.646917
Pork	.583224
Lamb	.636246
Chicken	.774894

Source: P. S. George and G. A. King, Consumer Demand for Food Commodities in the United States with Projections for 1980, Giannini Foundation Monograph No. 26, March, 1971, Calif. Ag. Exp. Sta., p. 62.

V. ECONOMIC IMPACT ANALYSIS METHODOLOGY

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

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

The determining force of plant shutdowns on these impacts is crucial; consequently, the Financial and Production effects, those which most immediately reflect plant shutdowns, will receive most emphasis in this financial and plant closure analysis.

In general, the impact analysis methodology is the same as that normally used in feasibility capital budgeting studies of new investments. Simply stated, the problem is one of deciding whether a commitment of time or money to a project is worthwhile in terms of the expected benefits derived. The decision in this case is complicated by the fact that benefits will accrue over a period of time and that in actuality no analyst is sufficiently clairvoyant or physically able to reflect upon all of the required cost and benefit analysis information which by definition must deal with projections of the future. In the face of imperfect, 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 analysis 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 differ from the model, and these differences must necessarily be considered in any interpretation of analytic data reflecting the behavior of model plants.

A. Fundamental Methodology

Much of the underlying analysis regarding price, financial, and production effects is applicable to all other impact effects. Consequently, the case methodology described here is conceptually integrated and the specific impact interpretations are discussed under their appropriate headings.

The core conceptual data used in this analysis are the physical and financial characteristics of the various industry segments as projected on the basis of model plants. The estimated cash flows for these model plants are summarized in Chapter III.

The primary factors involved in assessing the financial and production impact of pollution control are profitability changes and these, in turn, are a function of the cost of pollution control and the ability to pass along these costs in higher prices. In reality, of course, closure decisions are seldom made on the basis of well-defined common economic rules; such decisions invariably include a wide range of personal values, external forces such as the ability to obtain financing, or the role of the production unit in an integrated larger cost center.

Such variables include but are not limited to the following conditions and are generally characteristic of proprietorships and closely held enterprises rather than publically held corporations.

1. Production units may lack sufficient financial accounting data. This is especially likely to occur among small, independent operators who do not have effective cost accounting systems.

2. Production units may be so old and fully depreciated that management has no intention of replacing or modernizing them. Production continues only so long as it covers labor and materials costs and/or until the equipment becomes inoperative.

3. Marginally productive units may be acquired by new ownership that can re-evaluate existing assets or that can absorb temporary low returns with the expectation of eventual acceptable profit returns.

4. Production unit ownership may have value as psychic income. Such ownership, that is, may answer personal values that are great enough to override rational economic decisions.

5. The production unit, if part of a larger economic entity, may (1) use raw materials produced in another plant within the firm that must have an assured market or (2) supply raw materials to another unit within the firm. 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 adverse conditions and consequent losses are temporary. His ability to absorb short-term losses depends upon his access to funds through credit or personal resources not presently utilized.

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. Production units may also continue to function if 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.

While the above variable factors are frequently relevant to business decisions, economic rules are commonly universal. Thus, to provide as useful and reliable an insight into potential business responses to new investment decisions involving pollution control facilities, economic analysis will be used as the core analytical procedure. Given known pricing conditions, the impact of pollution control costs and resulting prices on profitability can be determined by employing 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 close when variable expenses (Vc) are greater than revenues (R). However, in practice plants may continue to operate where $Vc > R$ under such conditions as:

* a lack of cost accounting detail to determine when $Vc > R$,

* the opportunity cost of labor or other resource is less than market values (This would be possible in a proprietorship whose owner considers his labor as fixed.),

* other personal and external financial factors exist, or

* there are expectations that revenues will shortly increase to cover variable expenses.

A more probable situation is the case in which Vc < R but revenues are less than variable costs plus fixed, short-run cash overhead expenses (TCc). 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. Necessary to such a situation is the firm's expectation that revenues will increase to cover cash outlay. The conditions affecting closure decisions in such cases include:

* the extent of capital resources (If the owner has other business interests or debt sources that will supply capital input, the plant will continue.),

* there are inadequate cost accounting details or procedures to know that TCc > R (particularly in multiplant or business situation), or

* labor or other resources are considered fixed and the opportunity cost for these items is less than market value.

The identification of plants where TCc > R, but Vc < R leads to an estimate of plants that should eventually close if revenues do not increase. The timing of such closures, however, is difficult to predict.

The next level of analysis, where TCc < R, involves estimating the earnings before and after investment in pollution abatement. Under conditions in which TCc < R, it seems likely that investment in pollution control will be made and that plant operations will continue so long as the capitalized value of earnings (CV) (at the firm's 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 firm's (industry's) 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, the rate which measures after-tax profits as a ratio of invested capital. These ratios should not be viewed as a different estimate of profitability as opposed to DCF measures (discounted cash flow); they reflect an entirely different profitability concept. The reader is cautioned not to compare the DCF rates directly 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. The first is the internal rate of return or yield, and it 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 were returned from the 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 firm's 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.

Benefits

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

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

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 is omitted in the cash proceeds computation since it is reflected in the discount rate, the after-tax cost of capital (see 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, and carry forward and carry back provisions were not used due to their complexity and special limitations. Obviously, 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.

The revenue, expense, interest and depreciation charges used were those discussed in Chapter III and Chapter VI for pollution control facilities. These were assumed to be constant over the period of analysis.

Investment

Although investment is normally thought of as outlays for fixed assets and working capital, in evaluating the closure potentiality 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 in its opportunity cost or shadow price. [1/] For purposes of this analysis, sunk investment

[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 be different.

was taken as the sum of equipment salvage value plus land at current market value plus the value of the plant's net working capital (current assets less current liabilities, see Chapter III for values). This amount was taken as a negative investment in the terminal year. Replacement investment for plant maintenance was considered to be 66 percent of annual depreciation, a procedure which corresponds to the operating policies of some managements and which serves as a good proxy for replacement in an on-going business.

Investments in pollution control facilities are the estimates provided by EPA and shown in Chapter VI. Only incremental values were used.

Cost of Capital - After Tax

Return on invested capital is a fundamental notion in U. S. business. It provides both a measure of a firm's actual performance as well as its expected performance. In the latter case, it is also called the cost of capital. In this analysis the cost of capital is defined as the weighted average of the cost of each type of capital employed by the firm, generally its equities and interest bearing liabilities. There is no methodology that yields the precise cost of capital, but the cost 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:

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

where

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

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 an estimated 10 percent cost of debt and multiplying it 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 poultry processing industry was estimated as follows and was based on various Standard & Poor's industry survey:

Dividend Yield Plus Growth Method				
Capital	Weight	Cost	Growth	Cost
Equity	.60	.04	.09	.078
Debt	.40	.052	--	.0208
Average cost of capital				.0988
E/P Method				
Equity	.60	.143	--	.0858
Debt	.40	.052	--	.0208
Average cost of capital				.1066

As shown in the above computations, the estimated after-tax cost is 9.88 to 10.66 percent. The subsequent analysis was based on 10.0 percent.

[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.

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) book value of investment or replacement cost of investment taken in year t_o.

2. After tax cash proceeds taken for years t_1 to t_{30}.

3. Annual replacement investment, equal to 66 percent of 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.

6. Incremental pollution expenses taken for years t_1 to t_{30}.

7. Replacement investment equal to 66 percent of incremental annual depreciation on pollution control investment taken for years t_o to t_{30}.

B. Price Effects

At the outset, it must be recognized that price effects and production effects are so interrelated that each has an associated 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.

The determination of price effects requires a knowledge of demand growth, price and supply elasticities, the extent of regional market influence, the degree of large firm dominance in the industry, the market concentration of the industry's suppliers of inputs and purchasers of outputs, the organization of and coordination within the industry, the relationship between domestic output and the world market, the existence and nature of complementary goods, the industry's cyclical trends, the current utilization of the industry's capacity, and the effect of exogenous influences that bear upon price determination (e.g., governmental regulation).

In view of this complex diversity of factors involved in determining the market price, a purely quantitative approach to the problem of price effects is not feasible; hence, the simultaneous considerations suggested above have been made. The judgment factor was heavily employed in determining the supply response to a price change and the alternative price changes to be employed.

In order to provide a standard which would reflect price effects, this study computed an estimated price sufficient to insure plant profit stability. The required price increase at the firm level was evaluated in light of the relationship of the model plant to the industry and to the competitive characteristic of the industry. The required price increase was computed by the described DCF analysis. It dealt only with incremental pollution investment and cash proceeds.

The application of the above DCF procedure to these costs yielded the present value of pollution control costs (i.e., investment plus operating cost less tax savings). Wherever 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 was taxed at a rate of 48 percent.

C. Financial Effects

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

To measure profitability the analysis employed after-tax book rate of return on invested capital and cash flow (after-tax profit plus depreciation) measurements. After-tax profit as a percent of sales was reported in order to compare financial data with standard industrial measures.

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

Given these financial measurements, the ability of the industry to finance the required pollution control expenditures was reexamined in light of the financial results and the information shown in Chapter III The ability to do this varies from one industry subsector to another due to differential financial structures, profitability and abatement requirements; hence, capital availability and cost had to be examined on a model plant by model plant basis.

D. Production Effects

The potential production effects of the imposition of pollution controls include reductions of capacity utilization rates, plant closures and industry stagnation. Reductions in capacity utilization were estimated via qualitative techniques based upon the analysts' knowledge of the industry. The same was true for assessing the extent to which plant closures may be offset by increases in capacity utilization on the part of operating plants. Data limitations and time constraints required that the impact of pollution control standards upon future growth of the industry also be estimated via qualitative methods.

The remaining effect, plant closures, was difficult to measure realistically as discussed above in Section A. As a starting point in the plant closure analysis, a shutdown model was employed to indicate which model plants should close, which would function as marginal operations and which as sound. These conclusions assumed that a plant would close when its net present cash flow value is less than zero. However, the analysis recognized that model plants are theoretical and cannot project all relevant factors: thus, 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.

E. Employment Effects

Given the production effects of estimated production curtailments, plant closings and changes in industry growth, one recognizes that these factors affect industry employment. The employment effects stemming from each of these production impacts were estimated. Then the extent possible, the major employee classifications involved were examined as was the potential for re-employment.

F. Community Effects

Although the direct impacts of job losses upon a community are immediately apparent, in many cases, plant closures and cutbacks have a far greater impact than just that of 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 short-term and relatively minor within 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 were qualitatively analyzed as appropriate.

G. Other Effects

Other impacts such as direct balance of payments effects were also qualitatively analyzed.

VI. EFFLUENT CONTROL COSTS

Water pollution control costs used in this analysis were furnished by the Effluent Guidelines Division, Office of Air and Water Programs, Environmental Protection Agency from materials developed in part for 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 guidelines.

New Source Pretreatment Standards--to be applied to all facilities (that use municipal systems) constructed after promulgation of these guidelines--are assumed to have no impact on the industry due to the nature of the industry's effluent characteristics. The draft development document reports "no constituents of the effluent discharged from a plant within the poultry processing industry have been found which would interfere with, pass through, or otherwise be incompatible with a well-designed and operated, publicly owned activated sludge or trickling filter waste water treatment plant. The effluent, however, should have passed through by-product recovery and in-plant primary treatment in the plant to remove settleable solids and most of the grease." [2/]

1/ Draft Development Document for Effluent Limitations Guidelines and Standards of Performance for the Poultry Processing Industry, Prepared by North Star Research Institute for United States Environmental Protection Agency under Contract Number 68-01-0593, May, 1974.

2/ Ibid, p. 159.

A capital investment will be required of most plants with treatment systems to upgrade or install waste water treatment to achieve the waste water quality specified for 1977 and 1983. The estimated investment cost to achieve the 1977 limitations is based on an analysis of the treatment systems in use in the poultry processing industry and their effectiveness on poultry plant waste water. The costs for a "typical" plant to implement waste treatment to achieve the 1977 limitations are based on the following:

Addition of an anaerobic lagoon or the equivalent, or expenditure of same dollars on revision of present treatment systems.

Installation of water recirculation systems for feather flow-away water supply.

Installation of chlorination systems for the final effluent.

The following provide the basis for estimating the cost for the "typical" plant to implement waste treatment to achieve the proposed 1983 waste water limitations:

50 percent of the plants with waste treatment will have to add dry offal handling systems.

50 percent of the plants will have to install improved primary treatment such as dissolved air flotation.

Install a microscreen or sand filter or equivalent, as a tertiary treatment.

The cost of the irrigation option is presented to demonstrate the economic implications of a waste treatment system that produces no discharge.

The effluent control costs for each of the three treatment levels are based upon an assumption that baseline pre-BPT treatment includes primary and secondary systems represented as removal of settleable solids and grease plus a mixture of biological treatment.

The cost data provided by EPA applies to a series of "typical" plants and is reproduced in Appendix A of this report. Even though the cost

data were specified for more than one size of plant for most industry subsegments, those plant sizes do not correspond to the model plant sizes presented in this report. Based on discussions with EPA and North Star Research Institute personnel, DPRA estimated investment and annual treatment cost data for the model plants by assuming that, for a given treatment level, both investment and operating costs were a function of quantity of wasteflow. Given that assumption, each of the "typical" plants was 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, the fit is acceptable.

The resultant cost of treatment curves appear in Figures VI-1 through VI-8. The cost data for BAT represent the costs required beyond BPT expenditure levels. In each of the other cases, the data represent the incremental costs above baseline expenditures.

Production volumes and daily wastewater flow for each of the model plants appear in Table VI-1. The investment requirements for each level of abatement appear in Table VI-2 while operating costs are reported in Table VI-3. The investment costs include land, ($1,000 per acre) design and engineering (10 percent) and contingencies and omissions (15 percent) in addition to the basic treatment system.

Operating costs include labor, operation, maintenance, energy and power, supplies, chemicals, taxes, insurance and miscellaneous operating costs. In the case of irrigation, a by-product income credit of $20 per ton of dry hay at a yield of six tons per acre was taken.

Operating costs as reported in Table VI-3 exclude charges for capital costs and depreciation. Also, the operating costs exclude any monitoring costs which might be required to insure that the system is operating properly and that effluent limitations are being met. Although capital costs and depreciation are properly reflected in the impact analysis, monitoring charges are ignored and, to that extent, costs may be understated.

The draft development document recognizes that abatement costs for any given plant may deviate from those presented for the "typical" plant of equal production volume. For plants of equal flow, an accuracy of ± 20 to 25 percent is reported with the error factors rarely being minus. We assume this error range covers one standard deviation on either side of the "typical" plant with the "typical" plant representing the median. In averaging the wasteflows for the subcategories, one standard deviation of flow per unit of production was found to be 50 to 100 percent of the average.[3/] Given these levels of confidence, the

3/ Ibid, p. 128.

implication is that cost of treatment as reported for typical plants may be substantially above or below the costs required for any given plant. In the impact analysis chapter which follows, it is assumed that all plants will encounter costs equal to those for the typical plants. The extent to which cost variability might influence the impact of proposed standards is examined in Chapter VIII, below.

It is important to note that the cost data presented in this chapter only apply to direct dischargers and, hence, do not apply to those plants served by municipal sewers. With exception of the duck subsegment, municipal treatment of wastewater is common in the industry. The best indication of private versus municipal treatment currently available is North Star's extension of previous work conducted by the Economic Research Service of USDA (Table VI-4). The size classifications used in Table VI-4 are different than those used in this report and may be referenced in Appendix Table A-1. North Star's estimates of municipal treatment were adopted in this analysis.

Figure VI-1. Estimated typical plant incremental investment costs for implementing 1977 BPT limitations.

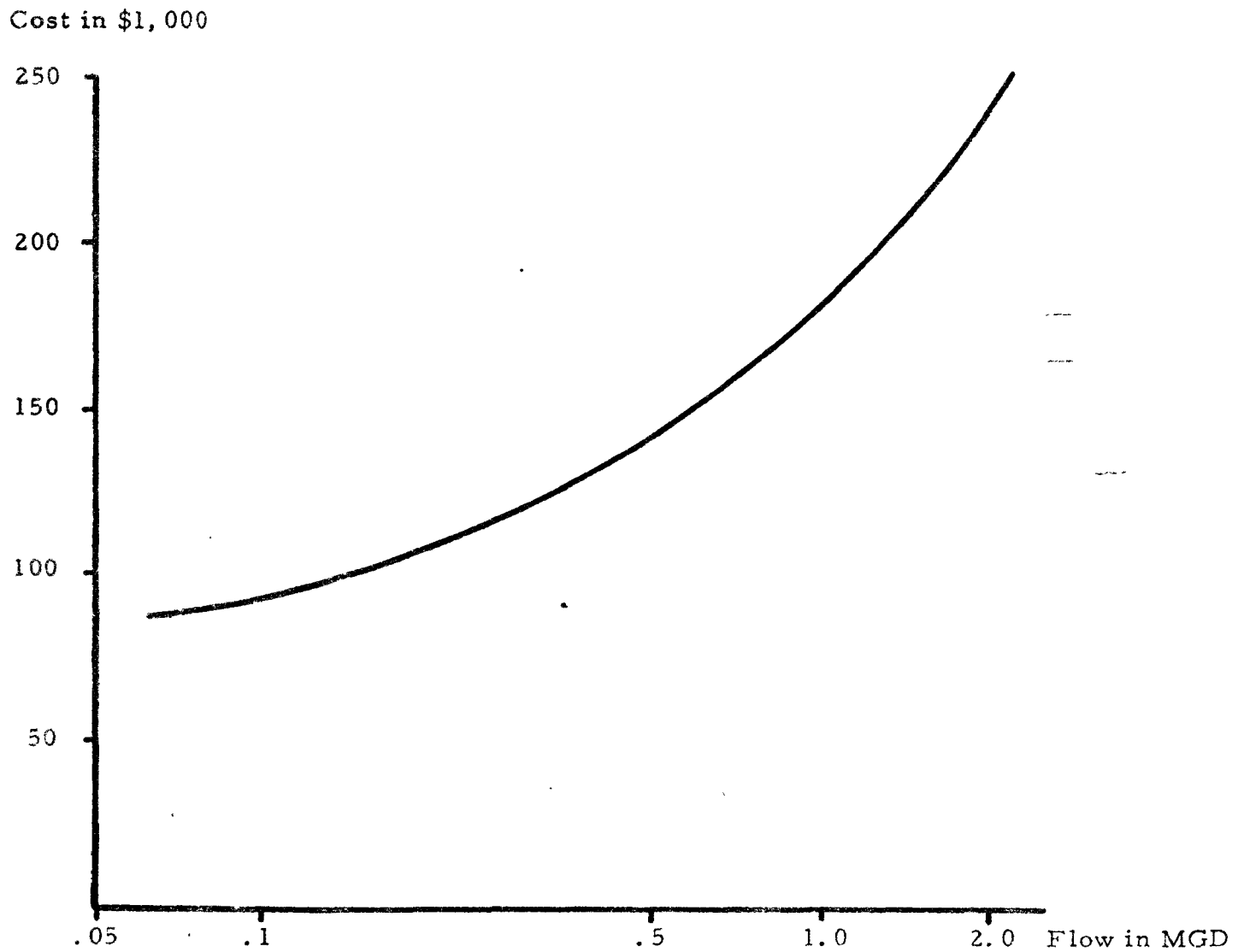

Figure VI-2. Estimated typical plant incremental investment costs for implementing 1983 BAT limitations.

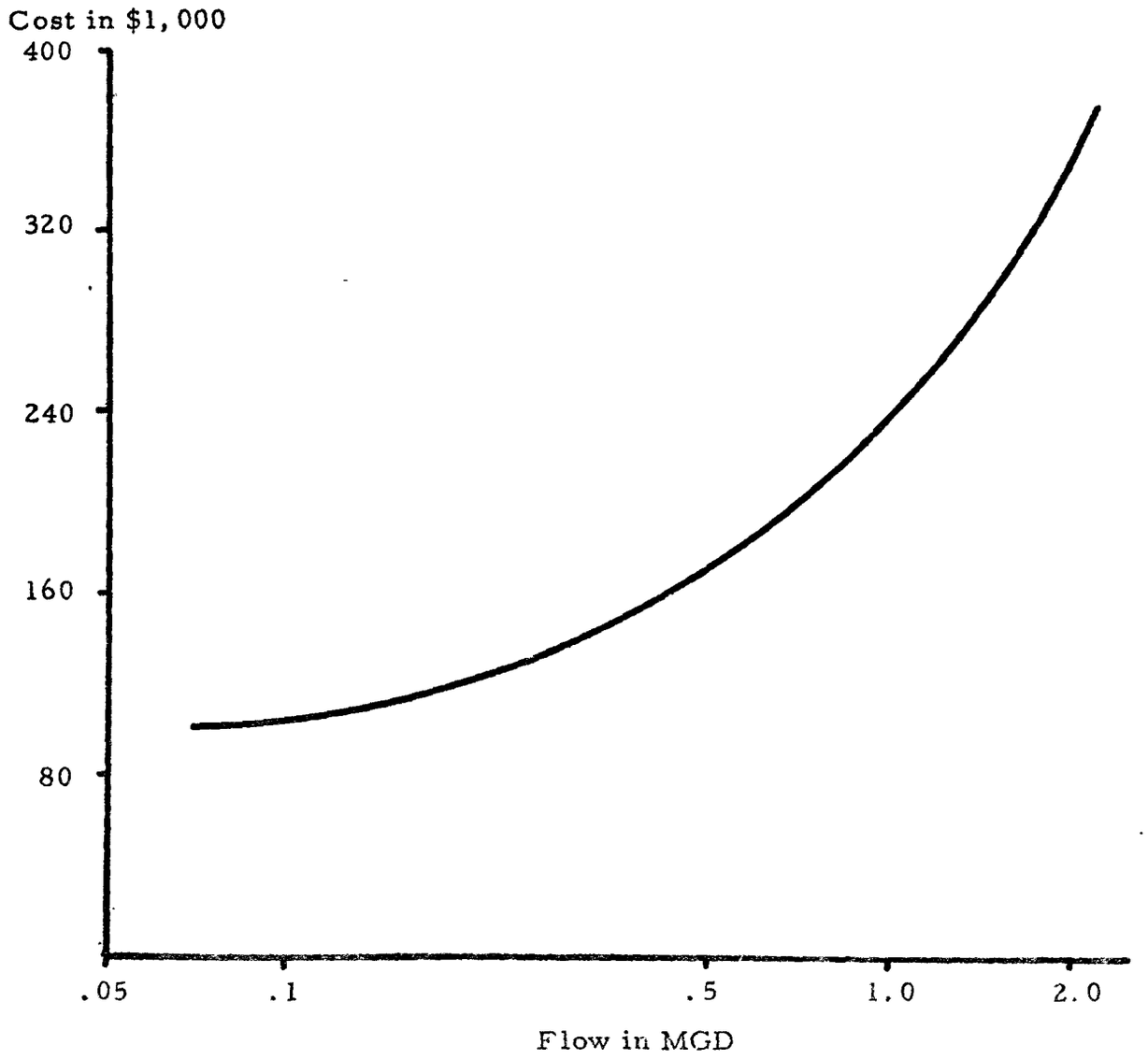

Figure VI-3. Estimated typical plant incremental investment costs for utilizing irrigation as a treatment strategy.

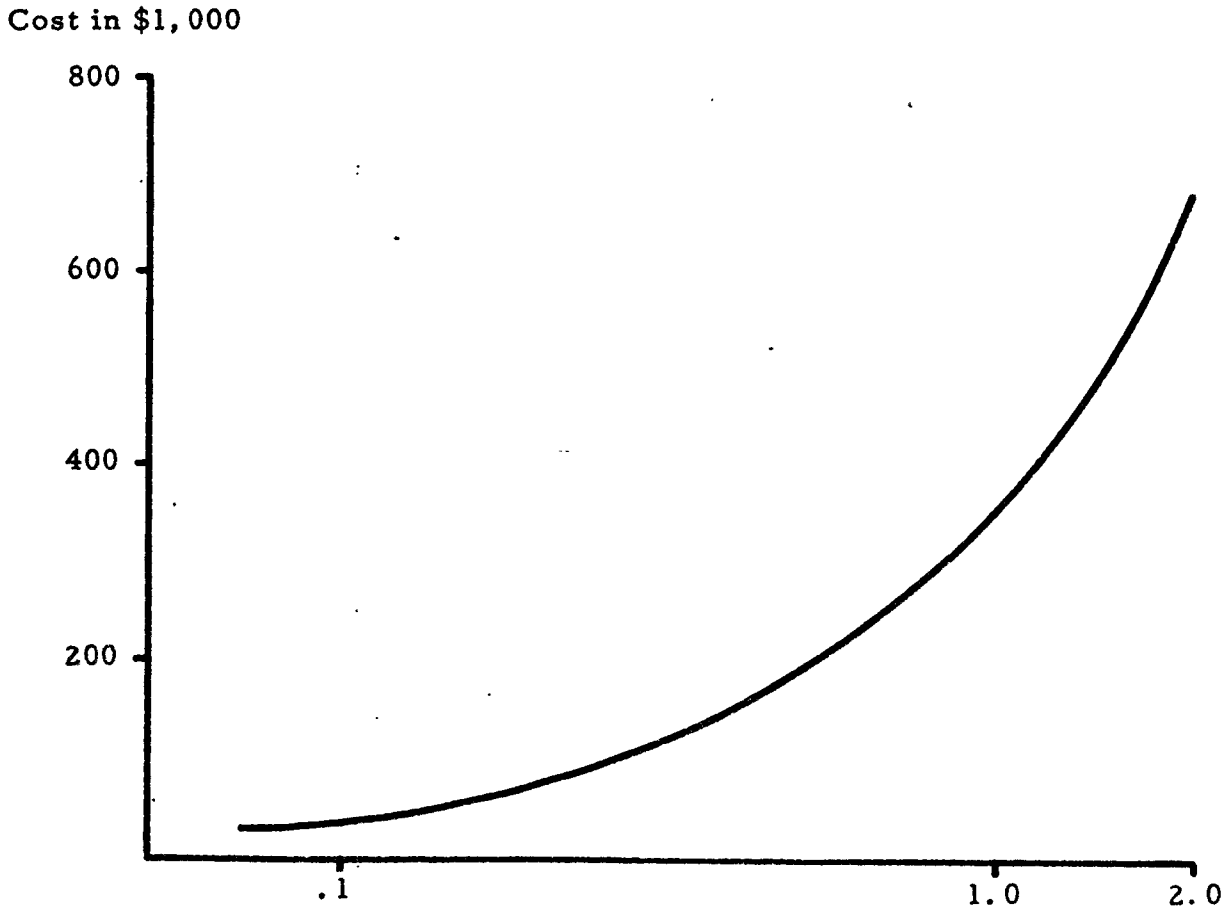

Figure VI-4. Estimated typical plant incremental investment costs for implementing New Source Performance Standards.

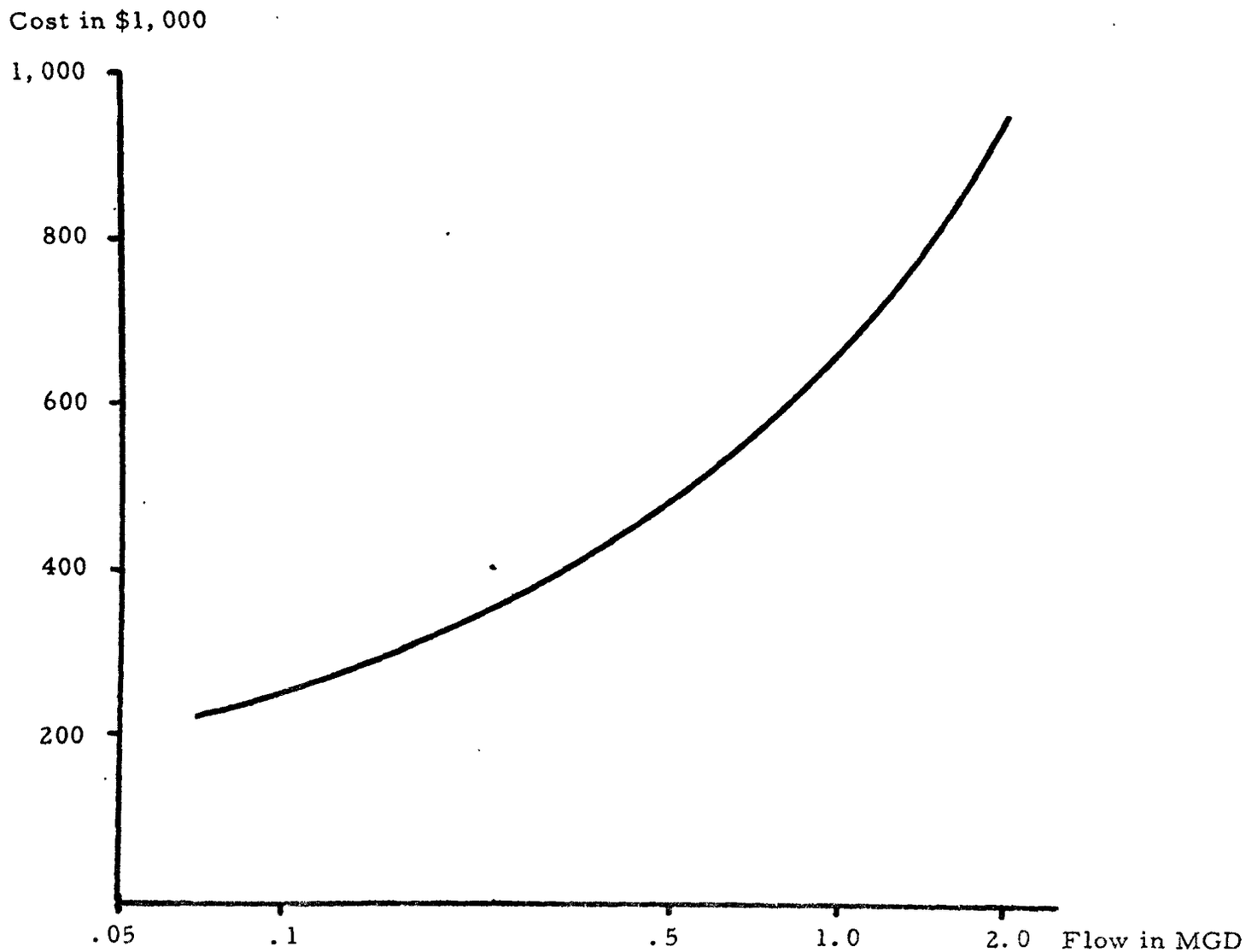

Figure VI-5. Estimated typical plant incremental annual operating costs for implementing 1977 BPT limitations.

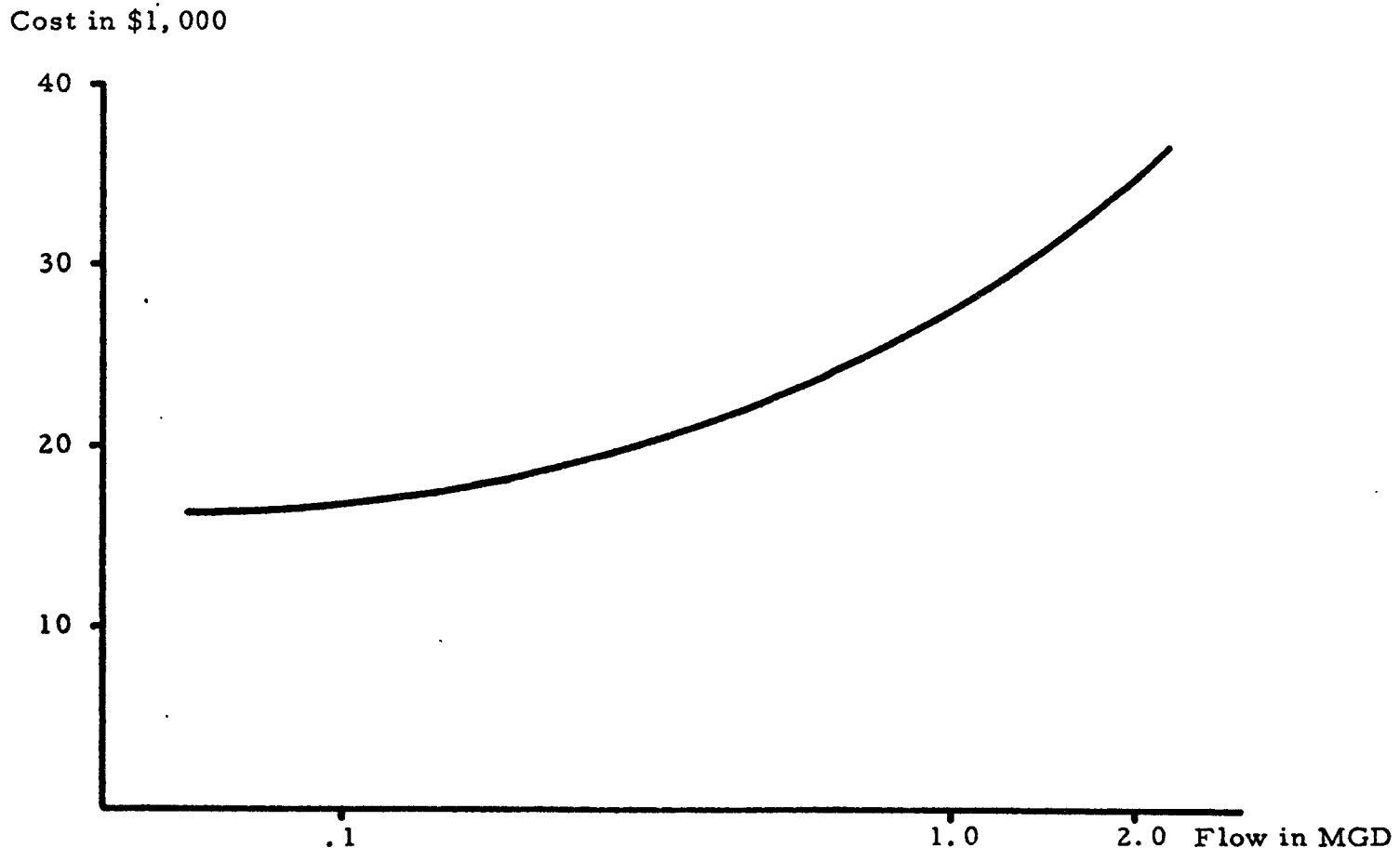

Figure VI-6. Estimated typical plant incremental annual operating costs for implementing 1983 BAT limitations.

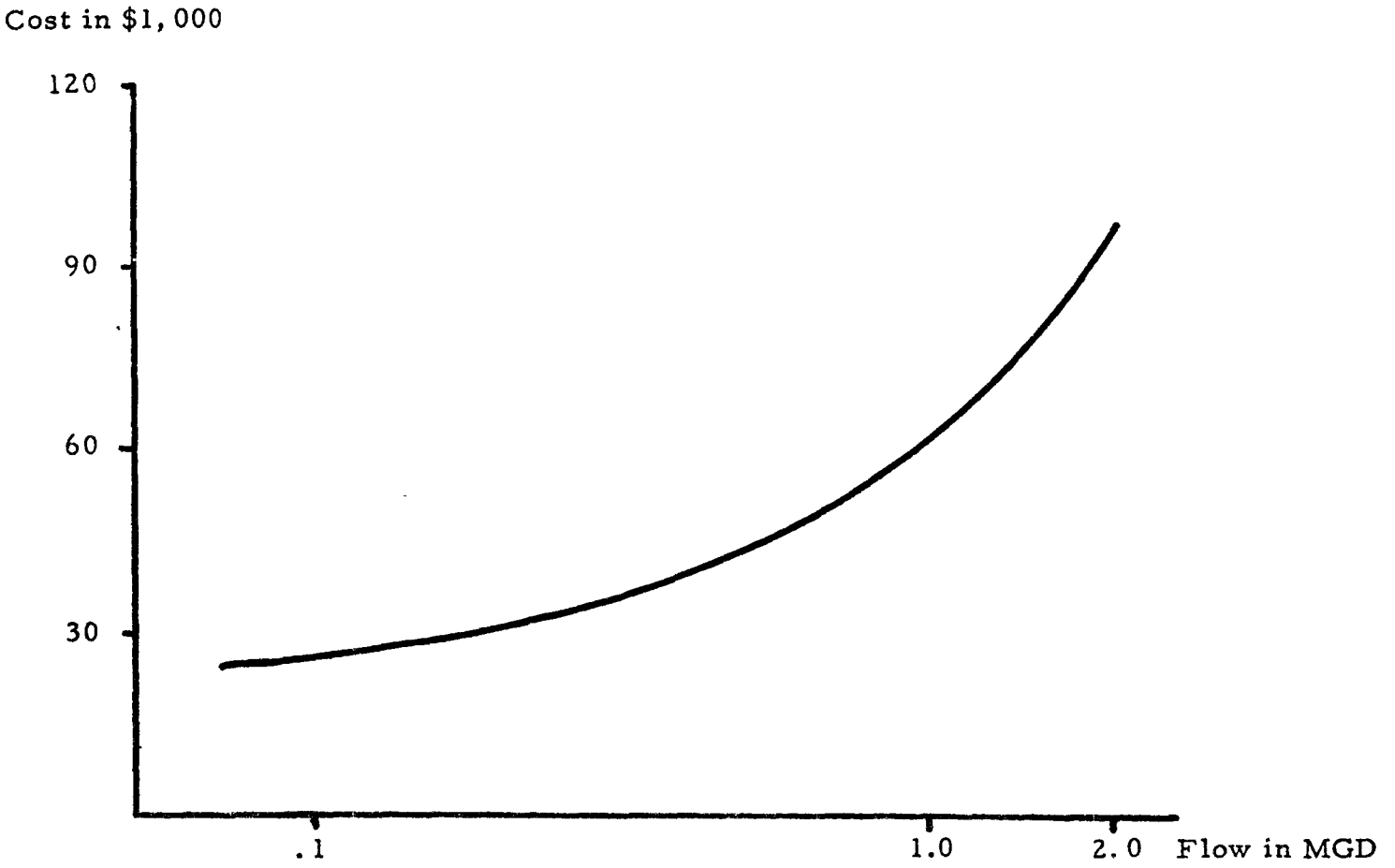

Figure VI-7. Estimated typical plant incremental annual operating costs for utilizing irrigation as a treatment strategy.

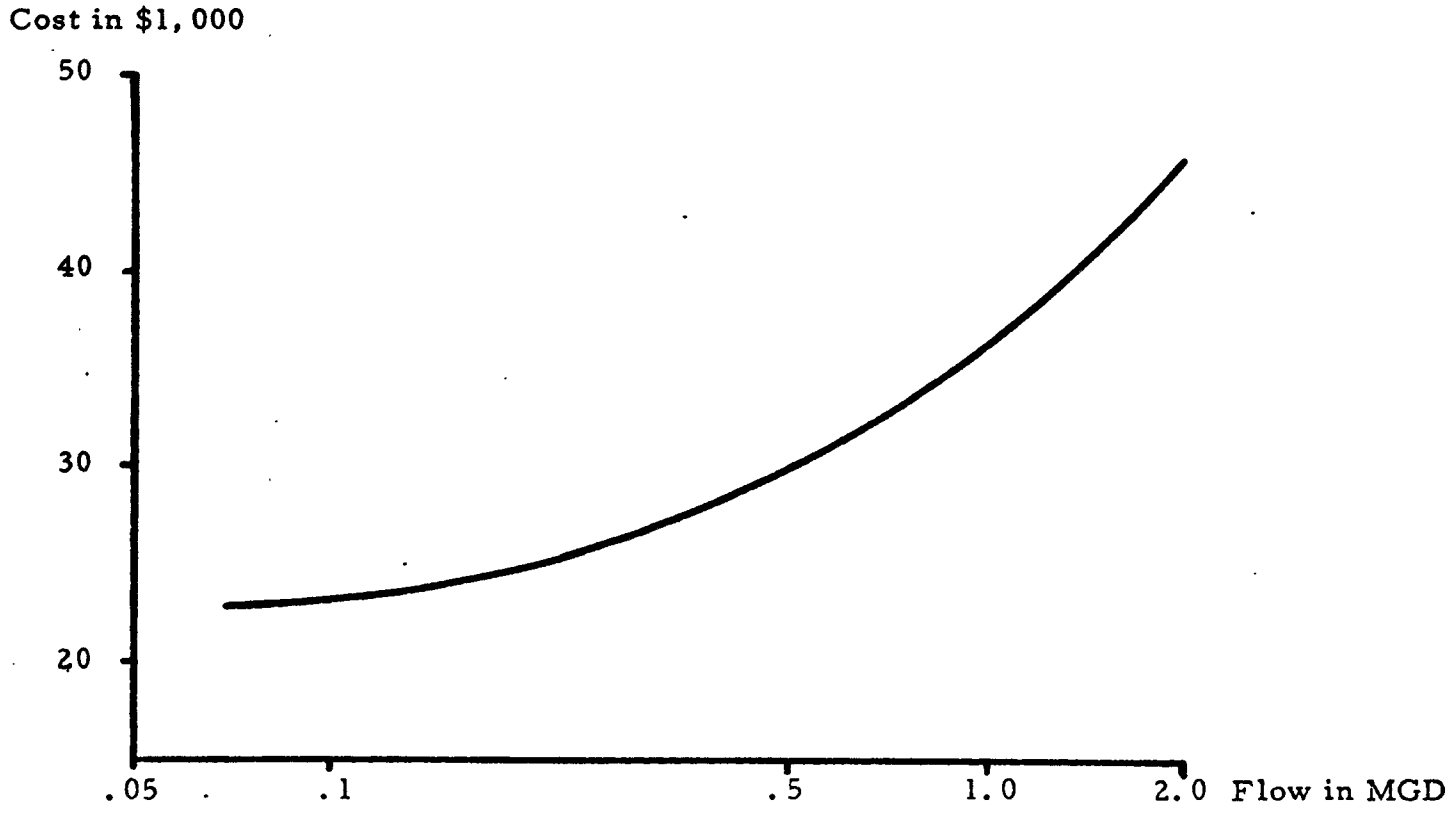

Figure VI-8. Estimated typical plant incremental annual operating costs for implementing New Source Performance Standards.

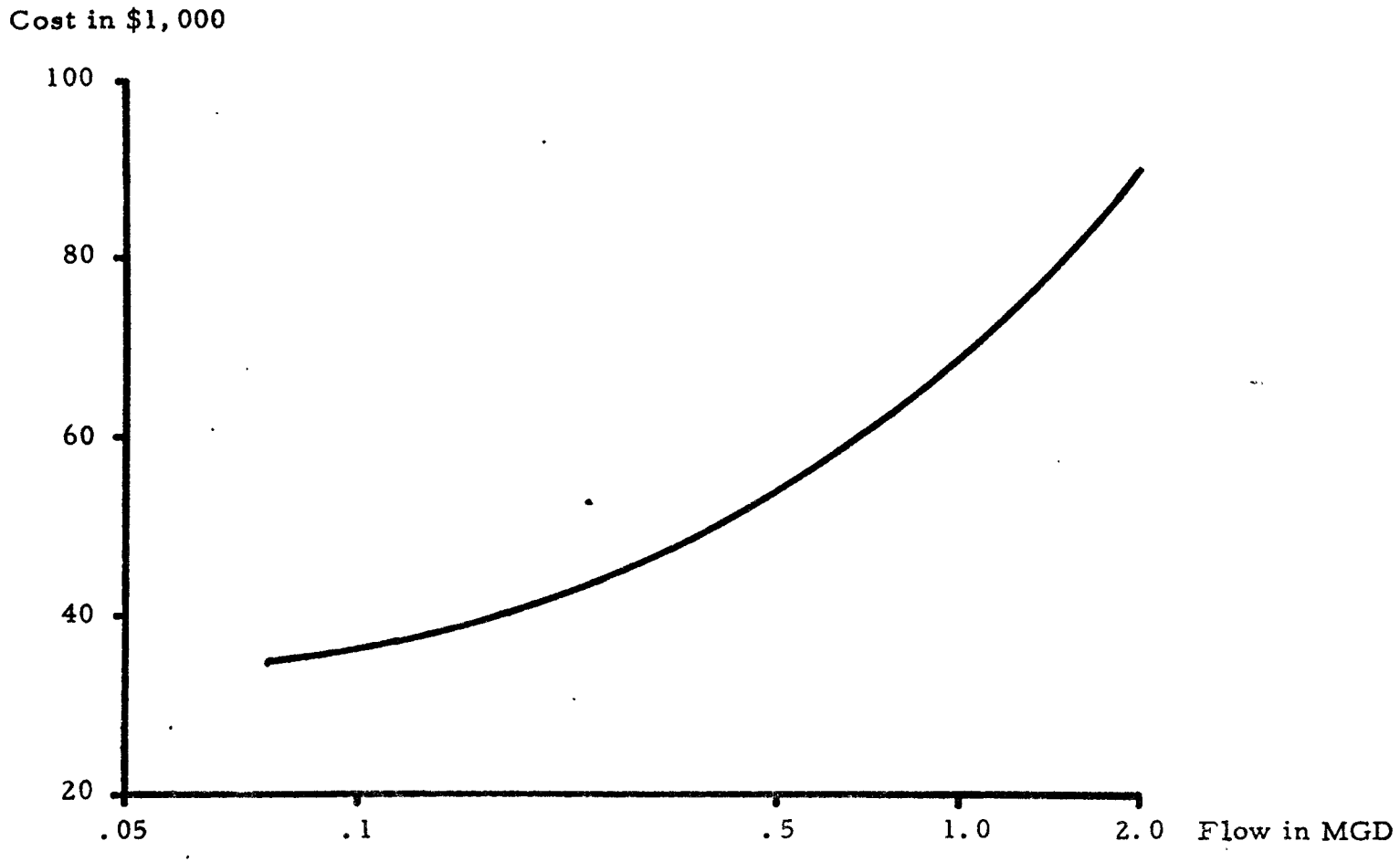

Table VI-1. Model plant average daily throughput and wastewater volume during peak operating month

Plant Type	Production Unit	Production Volume	Wastewater Volume MGD 1/
Young chicken			
Small	Birds/day	24,000	.223
Medium	"	48,000	.446
Large	"	76,800	.722
Very Large	"	112,000	1.053
Fowl			
Medium	"	38,400	.371
Turkey			
Small	"	7,200	.205
Medium	"	14,400	.410
Large	"	24,000	.684
Duck			
Medium	"	11,200	.269
Further Processing			
Medium	raw product lbs./day 2/	56,400	.085

1/ Wastewater volume per unit of production was calculated from the data presented in Appendix Table A-1. Daily astewater volume was calculated on the basis of production volume times per unit wastewater volume.

2/ A yield factor of 100 percent was utilized to convert from wasteflow per unit of finished product to wasteflow per unit of raw product (added ingredients -- bread, spices, juices, etc. -- provide an average 100 percent yield on further processed output).

Table VI-2. Estimated model plant incremental investment costs for implementing proposed limitations

Plant Type	Investment cost, by treatment level			
	BPT	BAT	NSPS	Irrigation
Young chicken				
Small	$112,000	$125,000	$343,000	87,000
Medium	137,000	162,000	465,000	175,000
Large	161,000	203,000	578,000	272,000
Very Large	185,000	246,000	686,000	375,000
Fowl				
Medium	130,000	151,000	428,000	144,000
Turkey				
Small	110,000	122,000	332,000	80,000
Medium	134,000	158,000	451,000	160,000
Large	158,000	197,000	561,000	259,000
Duck				
Medium	118,000	135,000	372,000	105,000
Further Processing				
Medium	91,000	104,000	241,000	36,000

Table VI-3. Estimated model plant incremental annual operating costs for implementing proposed limitations

Plant Type	Operating cost, by treatment level			
	BPT	BAT	NSPS	Irrigation
Young Chicken				
Small	$19,000	$32,000	43,000	25,000
Medium	22,000	41,000	53,000	29,000
Large	25,000	52,000	62,000	33,000
Very Large	28,000	63,000	71,000	37,000
Fowl				
Medium	21,000	38,000	50,000	28,000
Turkey				
Small	19,000	31,000	42,000	25,000
Medium	22,000	40,000	51,000	29,000
Large	25,000	50,000	61,000	33,000
Duck				
Medium	20,000	34,000	45,000	26,000
Further Processing				
Medium	17,000	26,000	36,000	23,000

Table VI-4. Industry breakdown by subcategory, size, and type of waste treatment

Plant Type	Percent of Subcategory Private, On-Site Treatment	Municipal Treatment	No Treatment
Chickens	29	69	2
Turkey	20	79	1
Fowl	19	76	5
Ducks	91	9	0
Further Processing Only	10	90	0
Total	26.2	72	1.8

Source: Draft Development Document for Effluent Limitations Guidelines and Standards of Performance for the Poultry Processing Industry, Prepared by North Star Research Institute for United States Environmental Protection Agency under Contract No. 68-01-0593, May, 1974, p. 124.

VII. IMPACT ANALYSIS

The imposition of effluent limitations on the poultry processing 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
E. Community Effects
F. Balance-of-Trade 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 poultry processing industry is one with a low value added and a very low profit margin in relation to sales. A small change in the wholesale price with live poultry prices and production costs staying constant results in substantial changes in industry profits. The converse of this argument is likewise true. Hence, if even a small increase in processor margins could be expected as a result of mandatory effluent treatment practices, the adverse economic impacts of those controls on the industry would be ameliorated. Unfortunately, we do not expect this to be the case except in the duck subsegment.

Historical poultry production costs, live prices and retail prices have been highly correlated in the long run--indicating that processors have little control over price (production costs in some cases) at either level. Also, the farm level demand for poultry is derived from the consumer demand at retail. If processors could act in unison, they could effectively shift the derived farm demand curve to the left while the consumer demand curve remained constant. These seemingly inconsistent viewpoints are partially explained by another 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 processor margins could be partially masked with both consumer and farm prices changing. However,

historical data do not support such a conclusion. The primary reason processors cannot control price margins is due to the competitive nature of the industry. Given the current and anticipated number and diversity of firms in the industry, collective actions to control margins would surely be futile.

The incremental costs of BPT treatment described in Chapter VI are small when compared to sales volume--less than 1.5 percent for each of the model plants (Table VII-1) but large when compared to profits. Economies of scale in effluent control become a major variable in determining the price adjustment necessary to offset the incremental cost factor of these controls. The necessary price adjustment to cover costs for the larger plants is much less than that for the smaller plants. Therefore, initial closures resulting from an inability to transfer these costs via wholesale price increases, would be concentrated in the smaller plant segments. The economies of scale, along with the fact that 72 percent of the plants are on municipal sewers, makes it doubtful that capacity will be reduced significantly by BPT closures.

Even though closures would not reduce capacity sufficiently to induce price changes, one might expect that 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 0.4 percent. The initial price response would develop as a result of decreased competition for live poultry (increased production costs for integrated firms). A price reduction or cost increase at the farm level would thus encourage farmers to reduce livestock production which, eventually, would mean consumers would find meat a little less plentiful and a little more expensive.

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 affected by the standards to which this report is addressed. Realizing that plants connected to sewers may incur a treatment cost and that those plants are reported by North Star to represent 72 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 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.

Table VII-1. Percentage incremental wholesale price* change required to completely offset abatement costs**

Plant Type	Treatment Level				
	BPT	BAT	BPT & BAT	NSPS	Irrigation
	(Percent change)				
Young chicken					
Small	1.1	1.4	2.5	2.8	1.0
Medium	0.6	0.9	1.5	2.0	0.8
Large	0.5	0.7	1.2	1.5	0.7
Very large	0.4	0.6	1.0	1.2	0.6
Fowl					
Medium	1.3	1.8	3.1	3.8	1.4
Turkey					
Small	0.9	1.3	2.2	2.7	0.9
Medium	0.6	0.8	1.4	1.7	0.7
Large	0.4	0.6	1.0	1.3	0.5
Duck					
Medium	1.2	1.7	2.9	3.4	1.3
Further Processing					
Medium	1.0	1.3	2.3	2.4	0.8

* Wholesale prices are those assumed for the model plants.

** Treatment costs as a percent of sales are 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.

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) in both 1977 and 1983 will equal private industrial treatment costs under baseline conditions. It is further assumed that the current market prices reflect baseline treatment costs and that baseline costs equal the currently prevailing treatment costs for sewered plants.

For those plants not discharging to municipal sewers, we therefore conclude that price changes which would offset effluent treatment costs are highly unlikely except in the duck subsegment where a long run wholesale price change of about 1 percent for BPT and 2 percent for BAT (about 3 percent total) is expected. Except for ducks, utilization of capacity is expected to increase for sewered plants and the remaining capacity will be absorbed by new plants constructed where sewer connections are available.

B. Financial Effects

In order to measure the financial impacts of proposed effluent controls on the poultry processing 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 invested capital
3. After-tax rate of return on invested capital
4. After-tax rate of return on sales
5. Annual cash flows
6. Cash flow as a percent of invested capital
7. Pollution abatement cash flow requirements
8. Net present values

Prior to examining the financial impacts, a few comments concerning the nature of the model plants are in order. The models are, in effect, financial profiles depicting the median plant within the plant type group. All plants within the plant type group are not identical and hence, deviations between the model plants and actual plants should be expected. While the model plant in a specific plant type group may show a profit, some plants in the group may be experiencing losses and vice-versa. In a statistical sense, then, the model plant is intended to represent the median plant of the plant type group distribution. Although the scope of this project did not allow a primary data survey to determine the types of distributions involved and their associated standard deviations, the reader should interpret the model plant data within such a framework. For example, one can assume that 50 percent of the plants are more profitable than the model being examined while 50 percent are less profitable.

Pre-tax Net Income

The impact of alternative effluent treatment levels on model plant pre-tax net income is shown in Table VII-2. The impact of BPT guidelines ranges from a 9 percent reduction in pre-tax income for the large turkey plant to a 49 percent reduction for the small chicken plant. In general, BPT standards impact the small plants severely while the impact on the large plants is only modest. In the case of BAT, however, the impact is severe for all plants--ranging from a pre-tax income reduction of 23 percent for the large turkey plant to 118 percent for the small chicken plant. Pre-tax income under irrigation is slightly higher than under BPT for the small plants but lower for the large plants. The NSPS pre-tax income levels are slightly less than the corresponding figures under BAT treatment.

Pre-tax Return on Invested Capital

Pre-tax return on invested capital for specified types and sizes of plants as affected by alternative effluent treatment levels is shown in Table VII-3. The impact pattern is similar to that described for pre-tax income effects.

After-tax Return on Invested Capital

After-tax returns on invested capital are shown in Table VII-4. Returns are relatively low even in the baseline situation. BPT controls severely impact the small plants and affect the large plants noticeably. BAT controls reduce returns to less than 7 percent for all plants but two and drop returns below 2 percent for three of the ten model plants. Returns under

Table VII-2. Pre-tax net income for poultry processing model plants at various effluent treatment levels, assuming no price changes.

Plant Type	Pre-tax net income *				
	Baseline	BPT	BAT	NSPS	Irrigation
			($1,000)		
Young chicken					
Small	76	39	-14	-23	41
Medium	202	157	90	73	152
Large	342	291	206	186	277
Very Large	522	464	360	339	443
Fowl					
Medium	130	88	25	10	85
Turkey					
Small	103	66	15	7	69
Medium	293	250	184	169	235
Large	582	531	448	430	519
Duck					
Medium	166	127	70	61	127
Further Processing					
Medium	233	201	159	158	206

* Average annual interest charges on pollution control equipment were calculated on the basis of a 10-year loan at 10 percent interest with fixed annual payments.

Table VII-3. Pre-tax rate of return on invested capital for model poultry plants at various effluent treatment levels, assuming no price change.

Plant Type	Pre-tax rate of return on invested capital*				
	Baseline	BPT	BAT	NSPS	Irrigation
	%	%	%	%	%
Young chicken					
Small	10.9	4.8	-1.5	-2.2	5.2
Medium	16.2	11.4	5.8	4.3	10.7
Large	17.9	14.1	9.1	7.5	12.7
Very Large	20.5	17.0	12.07	10.5	15.1
Fowl					
Medium	16.0	9.3	2.3	0.8	8.9
Turkey					
Small	11.2	6.4	1.3	0.6	6.9
Medium	18.6	14.6	9.8	8.3	13.5
Large	24.8	21.2	16.6	14.8	19.9
Duck					
Medium	16.3	11.2	5.5	4.4	11.3
Further Processing					
Medium	21.6	17.2	12.5	12.0	18.5

* Invested capital calculated as book value of model plant plus capital outlay required for pollution abatement. Book value of model plant equals depreciated value of fixed assets plus net working capital.

Table VII-4. After-tax return on invested capital for model poultry plants at various effluent treatment levels, assuming no price change.

Plant Type	After-tax rate of return on invested capital				
	Baseline	BPT	BAT	NSPS	Irrigation
	%	%	%	%	%
Young chicken					
Small	6.6	3.3	-1.5	-2.2	3.5
Medium	9.0	6.4	3.4	2.6	6.0
Large	9.7	7.6	5.0	4.2	6.9
Very Large	10.9	9.1	6.5	5.6	8.1
Fowl					
Medium	9.1	5.5	1.8	0.6	5.3
Turkey					
Small	6.5	4.0	1.0	0.4	4.2
Medium	10.1	8.0	5.5	4.7	7.4
Large	13.2	11.3	8.8	7.9	10.6
Duck					
Medium	9.1	5.4	3.4	2.7	6.4
Further Processing					
Medium	11.9	9.5	7.0	6.7	10.2

irrigation are slightly higher than under BPT for the small plants and lower for the large plants. Again, NSPS is slightly less than BAT.

After-tax Return on Sales

Chicken, fowl and turkey processing plants generally operate on an after-tax return on sales of 1 to 2 percent under average conditions. Duck and further processing plants yield successively higher returns. The proposed effluent limitations and standards impact this profitability measure in the same fashion as those previously discussed. Table VII-5 presents after-tax return on sales under baseline and proposed guideline conditions.

Annual Cash Flow

Estimated annual cash flows appear in Table VII-6. The severity of the impacts is especially apparent under BAT and NSPS conditions.

Cash Flow on Invested Capital

Annual cash flow as a percent of invested capital is shown in Table VII-7. Generally, the impact on this measure is similar to that for the previous measure. It is interesting to note, however, that BPT ranks better than irrigation in this framework--even for the small plants. This factor can be readily explained because of the large non-depreciable investment required for land in the case of irrigation.

Pollution Abatement Cash Flow Requirements

Although the impact of effluent controls on total cash flow is important, it is perhaps more meaningful to examine the cash flow requirements of the effluent treatment systems in light of the funds available to support such expenditures. As a first step, one can compare the cash flow requirements with after-tax profits as shown in Table VII-8. As a very rough rule of thumb, some analysts say that nonproductive capital outlays equalling 25 percent of annual net profits will have an appreciable impact, outlays of 50 percent will possibly result in a large number of plant closures and outlays of 75 percent will endanger the operations of nearly all plants in that subsegment. Applying that criteria would imply that most small plants would be appreciably to severely impacted by BPT guidelines while BAT would severely impact almost all non-sewered poultry processing plants. Where irrigation can be implemented at or near the costs estimated by North Star Research Institute, it would appear to be preferable to BAT, but more costly than BPT. Given the fact that 72 percent of the plants are sewered, the NSPS standards would appear to severely limit new plant construction where sewers are not available.

Table VII-5. After-tax return on sales for model poultry plants at various treatment levels, assuming no price change.

Plant Type	After-tax return on sales				
	Baseline	BPT	BAT	NSPS	Irrigation
	%	%	%	%	%
Young chickens					
Small	1.1	0.6	-0.3	-0.5	0.6
Medium	1.3	1.0	0.6	0.5	1.0
Large	1.3	1.1	0.8	0.7	1.1
Very Large	1.4	1.3	1.0	0.9	1.2
Fowl					
Medium	1.8	1.2	0.5	0.1	1.2
Turkey					
Small	1.2	0.9	0.2	0.1	0.9
Medium	1.7	1.4	1.1	1.0	1.3
Large	1.9	1.8	1.5	1.4	1.7
Duck					
Medium	2.4	1.9	1.1	0.7	1.9
Further Processing					
Medium	3.3	2.9	2.3	2.3	2.9

Table VII-6. Estimated cash flow for model poultry plants, at various effluent treatment levels, assuming no price change.

Plant Type	Estimated Cash Flow				
	Baseline	BPT	BAT	NSPS	Irrigation
			($1,000)		
Young chickens					
Small	89	80	52	53	75
Medium	179	169	150	158	163
Large	281	272	248	259	264
Very large	397	386	356	371	375
Fowl					
Medium	133	124	107	110	118
Turkey					
Small	127	119	102	105	113
Medium	259	248	230	238	237
Large	436	426	402	413	417
Duck					
Medium	174	166	150	156	160
Further Processing					
Medium	221	213	201	206	209

Table VII-7. Estimated cash flow as a percent of total invested capital for model poultry plants at various effluent treatment levels, assuming no price change.

Plant Type	Cash Flow on Invested Capital				
	Baseline	BPT	BAT	NSPS	Irrigation
	%	%	%	%	%
Young chickens					
Small	12.7	9.9	5.6	5.1	9.5
Medium	14.4	12.2	9.7	9.2	11.5
Large	14.7	13.2	10.9	10.4	12.1
Very large	15.6	14.1	11.9	11.5	12.8
Fowl					
Medium	16.3	13.1	9.8	8.9	12.3
Turkey					
Small	13.8	11.6	8.9	8.4	11.3
Medium	16.4	14.5	12.3	11.7	13.6
Large	18.6	17.0	14.9	14.2	16.0
Duck					
Medium	17.1	14.6	11.8	11.2	14.2
Further Processing					
Medium	20.5	18.2	15.8	15.6	18.7

Table VII-8. Model plant annual pollution abatement cash flow requirements as a percent of annual profits [1/].

Plant Type	Abatement cost as percent of profits				
	BPT	BAT	BPT &BAT	NSPS	Irrigation
Young chicken					
Small	50	65	115	131	52
Medium	25	35	60	72	34
Large	18	28	46	53	29
Very Large	13	22	35	41	26
Fowl					
Medium	35	50	85	101	46
Turkey					
Small	37	52	89	100	40
Medium	18	24	42	49	23
Large	10	17	27	31	17
Duck					
Medium	26	36	62	72	30
Further Processing					
Medium	15	20	35	36	13

1/ Abatement cash flow requirement calculated as annual operating costs, plus debt retirement at 10 percent interest on a 10-year loan (assuming 100 percent financing of abatement investment) less income tax reduction resulting from abatement costs.

Table VII-9 places the picture in a slightly different perspective. First, the plant's generation of funds above what must be reinvested to maintain productivity is presented. The figure is a composite of three components: (1) normal profits, (2) funds devoted to increasing productivity and efficiency and, possibly, (3) profits in excess of (or below) what is typical for the industry. Note, however, that reinvestment above 100 percent of depreciation is financed from one of the two profit sources. Hence, the column entitled Annual Net Cash Proceeds indicates the funds available to meet the pollution abatement cash flow requirements if the firm was willing to accept a zero return on equity and not invest any of its current cash flow potential on items to increase productivity and efficiency.

With the current and anticipated opportunities for investment, no firm would accept a long term return on equity of zero by choice! Also one would assume sewered plants will continue to increase productivity and efficiency which would place the non-sewered plants at a comparative disadvantage if all cash proceeds were devoted to pollution control. Lastly, if all cash proceeds were devoted to pollution abatement, no residual funds would be available for meeting any other non-productive investment requirements which might be imposed by the Federal, State, or local governments (e.g. APHIS of USDA, air programs of EPA, OSHA, etc.). Hence, in reality, only a portion of the net cash proceeds could be devoted to pollution abatement.

Table VII-9, then, seems to point to rather severe impacts. After implementation of BAT, over one-third of net cash proceeds will be required for pollution control for all but the very large chicken, the large turkey and medium further processing model plants.

Net Present Values

Net present values were calculated under baseline and proposed effluent treatment levels as the final step in the financial analysis. The net present values were calculated on the basis of a 32 year period with the investment taken in year zero, years 1-30 reflecting plant operations and salvage of the plant occurring in year 31. Year zero was assumed to reflect 1976 in all cases except BAT where 1982 was used. Investment outlays for pollution control were made in year zero. In the case of BAT, BPT was assumed to be inplace and have no market value. (Although BPT would have a book value and replacement value, these were not reflected in the calculations and, hence, one could argue that the net present values calculated on book and replacement investment basis are overstated at the BAT level.) This approach was taken because of the concern for reflecting the firm's ability to bear the cost of pollution abatement rather than obtain a yield on pollution abatement investments.

Table VII- 9. Model plant annual net cash proceeds compared with annual cash flow required to pay for pollution abatement

Plant Type	Annual[1/] Net Cash Proceeds	Annual Abatement Cash Flow Requirements[2/]				
		BPT	BAT	BPT & BAT	NSPS	Irrigation
	($1,000)					
Young chicken						
Small	62	23	31	54	63	25
Medium	135	27	39	66	81	38
Large	217	31	51	82	98	54
Very Large	318	36	60	96	115	71
Fowl						
Medium	94	26	37	63	75	34
Turkey						
Small	83	22	31	53	60	24
Medium	194	28	39	67	78	37
Large	352	31	52	83	96	52
Duck						
Medium	121	24	33	57	67	28
Further Processing						
Medium	160	19	26	45	46	17

1/ Annual after tax profit plus 34 percent of depreciation under baseline conditions.

2/ Annual operating costs plus debt retirement at 10 percent interest on a 10-year loan (assuming 100 percent financing of abatement investment) less income tax reduction resulting from abatement costs.

By 1982, BPT should be nearly paid for and an annual reinvestment allowance to replace BPT equipment, when required, is included in the cash flows. The reinvestment allowance is taken at 66 percent of depreciation in each case. This is just slightly higher than would be required for payments to a sinking fund to replace the equipment every 10 years assuming a 10 percent return on the fund. A 10 percent discount rate reflecting the estimated cost of capital was used for all plants. The construction of the cash flows used in the analysis is fully described in Appendix B of this report.

Net present values for baseline conditions appear in Table VII-10. The values are positive for all model plants when plant salvage value is used as the investment basis. When book value is used, only the small chicken and turkey plants fall below zero. When replacement investment is used as the basis, all models reflect negative net present values. This latter condition seems quite consistent with the fact that very few new poultry processing plants have been constructed during the past few years.

Net present values under BPT limitations appear in Table VII-11. The small chicken model is the only one which falls below zero when plant salvage value is used as the investment basis. However, significant reductions can be seen in all of the values when compared to baseline conditions.

The small turkey plant as well as the small chicken plant exhibit negative present values when salvage value of the plants are used as the investment basis. The impact of BAT limitations cause 7 plants to drop below zero when the book value basis is used. As suggested earlier, we assume 50 percent of the plants would have net present values lower than those of the corresponding model. The resultant implications of the BAT financial impact indeed appear to be serious. It should be recalled at this point that, except for ducks, no price increases are expected to lessen the financial impact.

For comparative purposes, net present values assuming irrigation as the treatment strategy appear in Table VII-13. Irrigation shows a slight advantage over BPT for the small chicken and medium further processing plants. The impact of irrigation is less severe than BAT in all cases.

New Source Performance Standards' impact on net present value is presented in Table VII-14. These values must be compared with the replacement column of Table VII-10 (baseline net present values) for proper interpretation. As can be seen, NSPS standards will make it much more difficult to warrant new plant investment.

Table VII-10. Net present value of baseline DCF cash flow under alternative investment valuations.

Plant Type	Net present value of cash flow less investment at*		
	Salvage	Book ($1,000)	Replacement
Young chicken			
Small	189	-4	-709
Medium	583	283	-815
Large	989	555	-1026
Very Large	1552	1023	-909
Fowl			
Medium	489	223	-739
Turkey			
Small	288	-10	-1077
Medium	942	499	-1115
Large	1967	1395	-728
Duck			
Medium	690	344	-1052
Further processing			
Medium	1052	653	-872

* Investment in year zero taken at salvage, book or replacement value. Investment is liquidated in year 31 at salvage value in each case.

Table VII-11. Net present value of DCF cash flow under alternative investment valuations after implementation of BPT limitations, with no compensating price increases.

Plant Type	Net present value of cash flow less investment at*		
	Salvage	Book	Replacement
Young chicken			
Small	-36	-229	-934
Medium	314	14	-1084
Large	667	243	-1338
Very Large	1207	678	-1254
Fowl			
Medium	227	-39	-1001
Turkey			
Small	74	-224	-1291
Medium	667	224	-1390
Large	1658	1086	-1037
Duck			
Medium	449	103	-1293
Further Processing			
Medium	867	468	-1057

* Investment in year zero taken at cost of pollution control equipment plus salvage, book or replacement value of other assets. Investment is liquidated in year 31 at salvage value in each case. Salvage value of pollution control equipment is assumed to equal zero.

Table VII-12. Net present value of DCF cash flow under alternative investment valuations after implementation of BAT limitations, with no compensating price increases.

Plant Type	Net present value of cash flow less investment at*		
	Salvage	Book ($1,000)	Replacement
Young chicken			
Small	-237	-430	-1135
Medium	63	-237	-1335
Large	343	- 91	-1672
Very Large	797	268	-1669
Fowl			
Medium	1	-265	-1227
Turkey			
Small	-117	-415	-1482
Medium	416	- 25	-1641
Large	1336	764	-1359
Duck			
Medium	244	-102	-1498
Further Processing			
Medium	703	304	-1221

* Investment in year zero taken at cost of pollution control equipment plus salvage, book or replacement value of other assets. Investment is liquidated in year 31 at salvage value in each case. Salvage value of pollution control equipment is assumed to equal zero.

Table VII-13. Net present value of DCF cash flow under alternative investment valuations with irrigation as a treatment strategy with no compensating price change.

Plant Type	Net Present Value of Cash Flow Less Investment at *		
	Salvage	Book	Replacement
	($1,000)		
Young chicken			
Small	-28	-221	-926
Medium	252	-48	-1,146
Large	535	101	-1,480
Very Large	970	441	-1,491
Fowl			
Medium	197	-69	-1,031
Turkey			
Small	78	-220	-1,287
Medium	626	183	-1,431
Large	1,535	963	-1,160
Duck			
Medium	444	98	-1,298
Further Processing			
Medium	893	494	-1,031

* Investment in year zero taken at salvage, book or replacement value. Investment is liquidated in year 31 at salvage value in each case.

Table VII-14. Net present value of DCF cash flow after implementation of new source performance standards, with no compensating price increases.

Plant Type	Net Present Value ($1,000)
Young chicken	
Small	-1,325
Medium	-1,661
Large	-2,035
Very Large	-2,092
Fowl	
Medium	-1,513
Turkey	
Small	-1,708
Medium	-1,931
Large	-1,719
Duck	
Medium	-1,707
Further Processing	
Medium	-1,330

Special Considerations for Multi-Class Plants

The effluent treatment cost data presented in the previous chapter are based upon an assumption of single class operation -- i.e. slaughter plants slaughter only one class of poultry and perform no further processing and further processing plants conduct no slaughter activities. As noted in Chapter I of this report, 30 percent of the slaughter plants mix classes to some extent and 50 percent of the further processing plants have slaughter operations. Further, we estimate that 10 percent of the slaughter plants have further processing operations.

For the purposes of this study, we have assumed that the mixing of classes will result in the plants having at least as severe an impact - possibly greater--than that shown for the single class models above. In those cases where more than one class of poultry are slaughtered simultaneously (not a very common practice) the costs and impacts would equal the weighted average for the classes involved. In those cases where classes are run separately within a short time interval (e.g. a week), the results would still probably approximate a weighted average. However, in those cases where the classes are run separately with each class slaughtered for a prolonged period, it would appear the plant would have to have a treatment system designed for the class generating the largest flow. In those situations, the impacts would be more severe than one would surmise from examining the model plants. This fact is of special interest since about 70 percent of the multi-class slaughter plants fall in the small size categories.

Based on data provided by EPA and North Star, it is assumed that those slaughter plants with only a small amount of further processing will not have appreciably higher costs. For those plants which are actively engaged in further processing but for less than 50 percent of their slaughter, costs would probably increase about 7 percent. When further processing exceeds 50 percent of the slaughter, wastewater treatment costs would increase about 17 percent. In view of the added profits from further processing, the single class based impacts should also represent the slaughter plus further processing plants fairly well.

The existence of cut-up operations in slaughter plants should not appreciably affect wastewater flow or treatment costs. To the extent that cut-up activities may strengthen profit margins somewhat, the impact on slaughter only plants may be slightly higher than on slaughter plus cut-up plants.

For those plants classified as further processors with slaughter, the treatment costs would, presumably, equal the cost for further processing plus the incremental cost for slaughter calculated by summing the two flow components and referencing the figures in Chapter VI above. The net result would be a financial impact between that shown for the slaughter only and further processing only model plants.

C. Production Effects

The proposed effluent limitations are not expected to have a significant long run impact on the product volume of poultry. The impact of the guidelines will principally be reflected in a dramatic shift in production away from plants served by private effluent treatment systems to sewered plants. The exception to this generalization is the duck subsegment where a reduction in productive capacity and a slight reduction in production is anticipated.

Plant Closures

As noted in Chapter II-A, there has been a 50 percent decline in number of plants between 1958 and 1972. More recently, from 1967 to 1972, the industry experienced closures of 24 percent. The closures appear to have resulted from normal maturation of the industry which can be characterized by improved technology, economies of scale, intense competition and volatile earnings in the short-run. These factors sometimes create critical problems of capital availability and liquidity. Therefore, we are projecting approximately 13 percent baseline closures as shown in Table VII-15. These closures are our estimates of the impact of natural market forces plus other regulations not pertaining to the proposed guidelines. The reduced capacity implied by these closures will normally, as in previous years, be offset by new plant construction. The new plants will be connected to municipal sewers or will be very large such that economies of scale make them unlikely candidates for closure due to pollution control requirements.

For the purposes of this analysis, the industry was viewed as comprising the plants remaining after baseline closures. The number of plants subject to BPT and BAT limitations were then determined by applying the percent of plants on private treatment (Table VI-4, Chapter VI) to the total number of plants in each of the industry subsegments. For the further processing plus slaughter subsegment, which was not presented separately by North Star, we estimate 20 percent of the plants are on private treatment systems. The resultant number of plants subject to the guidelines appear in the first column of Table VII-16.

Closure decisions are seldom made on the basis of well defined common economic rules; such decisions invariably include a wide range of personal values, external forces such as the ability to obtain financing, or the role of the production unit in an integrated firm (see discussion in Chapter V). However, it must be recognized that profitability remains as a major determinant of the viability of that firm. For this reason plant

Table VII-15. Baseline plant closure estimates

Plant Type	Number of Plants		
	Current	Baseline Closures	Remaining
Young chicken			
Small	157	30	127
Medium	73	7	66
Large	40	3	37
Very Large	36	2	34
Total	306	42	264
Fowl			
Total	50	8	42
Turkey			
Small	93	15	78
Medium	41	2	39
Large	10	0	10
Total	144	17	127
Duck			
Total	17	2	15
Further Processing Only			
Total	20	1	19
Further Processing with Slaughter			
Total	20	2	18
Total Industry	557	72	485

Table VII-16. Estimated plant closures resulting from imposition of BPT limitations

Plant Type	Plants subject to guidelines	Number of plants closed
Young chicken		
Small	40	15
Medium	21	3
Large	11	1
Very Large	10	0
Total	82	19
Fowl		
Total	10	2
Turkey		
Small	16	4
Medium	8	1
Large	2	0
Total	26	5
Duck		
Total	14	1
Further Processing Only	2	0
Further Processing with Slaughter	4	0
Total Industry	138	27

closures, to a large extent, are determined by the financial impact of effluent control costs on firms that are unable to offset these costs via price increases for their product output.

The determination of plant closures then considers the financial effects in light of profitability, capital availability -- either generated internally or acquired from external sources, and future expectations for the industry (see Chapter II for a discussion of financial considerations).

To measure profitability, the analysis employed after-tax book rate of return on invested capital and cash flow measurements. The after-tax return for the model plants is summarized in Table VII-4. It should be re-emphasized that caution must be used in interpretation of model plant results. These plants are designed to represent averages and approximately 50 percent of actual plants are likely to be more profitable while 50 percent of the plants are likely to be less profitable.

Given the cost of capital as 10 percent, it can be observed that at baseline conditions only 4 of the 10 plants have an after-tax return on invested capital that exceeds the cost of capital. As expected, the imposition of effluent control costs depress these returns to questionable levels. The acquisition of external capital becomes extremely difficult, and at best, very costly, under the above conditions. This can be confirmed by the low price/earnings ratio of poultry processing firms that are publicly traded. In many cases, these firms are selling well below book value. This measure indicates many firms will have extreme difficulty obtaining external funds to finance pollution control cost.

The cash flow measurements are summarized in Tables VII-6 through VII-8. As pointed out in the previous discussion, as a rough rule of thumb, some analysts say that nonproductive capital outlays equalling 25 percent of annual net profits will have an appreciable impact, outlays of 50 percent will possibly result in a large number of plant closures and outlays of 75 percent will endanger the operations of nearly all plants in that subsegment. The latter category would include the small chicken, fowl and small turkey plants.

The discussion of net present values begins on page VII-14 and the data are summarized in Tables VII-10 through VII-14. From a strictly economic basis, ceteris paribus, a firm would close when its net present cash flow is less than zero. However, the analysis recognized that model plants are theoretical and cannot project all relevant factors involved in the shut-down decision. Nevertheless, net present value does provide an additional tool for the analysis.

Given the previously developed quantitative measures, the estimated plant closures become a qualitative decision incorporating the quantitative tools as well as qualitative judgments of the analyst.

Estimated plant closures attributable to BPT guidelines are shown in Table VII-16. A total of 27 closures are expected. Most of these are in the small size categories. The closures equal 20 percent of the plants on private treatment but only 6 percent of all plants remaining after baseline closures.

Slightly over one-half of the anticipated closures are attributed to the small plants in the young chicken subsegment. In total, the young chicken subsegment will experience 70 percent of the BPT closures while representing only 59 percent of the plants on private treatment.

Plant closure estimates attributed to the incremental impact of BAT guidelines appear in Table VII-17. Of the plants on private treatment after implementation of BPT limitations, 34 percent are expected to face closure. The guidelines would eliminate most of the small plants in the young chicken subsegment. Other segments with rather severe impact are the medium young chicken, fowl and small turkey plants. It is felt the effects on the remaining segments could either be absorbed or result in minimal closures.

A summary of the collective impact of BPT and BAT guidelines is presented in Table VII-18. A total of 65 plants or approximately 47 percent of the plants subject to the guidelines are expected to close. It is well to note, however, that 36 of the 65 plants are in the small young chicken segment which appears to be rather marginal at the present time.

The above plant closure estimates may be overstated at the BAT level to the extent that some plants may choose to select zero discharge via irrigation as an effluent treatment strategy. As shown earlier, irrigation is cheaper than BAT. Of course, that conclusion is predicated on the assumptions that land is available at a cost of $1,000 per acre and that soil conditions, etc. are conducive to the irrigation strategy. Unfortunately, the scope of this study did not permit an examination of the degree to which irrigation could be substituted for BAT treatment.

Production Curtailment

As noted in Table VI-4 of the preceding chapter, 69 percent of the young chicken, 76 percent of the fowl and 79 percent of the turkey plants are sewered. We assume that the average production volumes in sewered

Table VII-17. Estimated plant closures resulting from imposition of BAT limitations

Plant Type	Plants subject to guidelines	Plants Closed
Young chicken		
Small	25	21
Medium	18	6
Large	10	1
Very Large	10	0
Total	63	28
Fowl		
Total	8	3
Turkey		
Small	12	6
Medium	7	0
Large	2	0
Total	21	6
Duck		
Total*	13	1
Further Processing Only	2	0
Further Processing with Slaughter	4	0
Total Industry	111	38

* Plant closures for ducks estimated at 5 prior to an allowance for anticipated price increases.

Table VII-18. Combined plant closure impacts resulting from imposition of BPT and BAT limitations

Plant Type	Number of Plants		
	Prior to BPT**	BPT and BAT Closures	Plants Remaining
Young chicken			
Small	40	36	4
Medium	21	9	12
Large	11	2	9
Very Large	10	0	10
Total	82	47	35
Fowl			
Total	10	5	5
Turkey			
Small	16	10	6
Medium	8	1	7
Large	2	0	2
Total	26	11	15
Duck			
Total *	14	2	12
Further Processing			
Total	6	0	6
Total Industry	138	65	73

* Plant closures for ducks were estimated at 6 prior to an allowance for anticipated price increases.

** Includes only those plants subject to BPT and BAT guidelines and, therefore, excludes those plants connected to municipal sewer systems.

plants roughly equals that of the nonsewered plants. It is also assumed that reductions in productive capacity due to baseline conditions will be offset by additions of plants served by municipal sewers.

Plant closures resulting from BPT limitations would reduce the industry's productive capacity by about 3 percent. With the exception of a few cases where geographic isolation is a dominant factor, the remaining plants in the industry should be able to increase production volume enough to offset the reduced capacity. This conclusion holds for ducks as well as the other subsegments.

Reductions in capacity due to BPT plus BAT closures will approximate twice that of BPT alone. Given the time log in implementation of BPT and BAT, it is expected that the remaining plants should be able to increase production volume to offset the reduced capacity. Therefore, in all segments but ducks, the production and price levels should remain relatively stable at baseline levels plus anticipated growth in the long run.

Impact of New Source Performance Standards

The potential impact of New Source Performance Standards is best analyzed by estimating the percentage of baseline plants with profits large enough to warrant the current cost of constructing a new plant under both baseline and NSPS treatment. Such estimates for poultry processing plants appear in Table VII-19. It should be recalled that the NSPS standards apply only to those plants on private treatment systems. As can be readily observed, the standards would significantly dampen new plant construction in non-sewered areas. For the industry as a whole, we estimate 5 percent of the plants could warrant new plant construction costs under baseline conditions. Under NSPS guidelines, however, it is estimated that only 1 percent of the total plants would have profits of sufficient magnitude to warrant construction of new plants.

D. Employment Effects

As stated in Section C above, a substantial number of plant closures are anticipated as a result of imposing the proposed effluent guidelines. The employment and payroll loss as a result of these plant closures are estimated as shown in Table VII-20. Lost jobs are estimated at 3,425 and 4,800 for BPT and BAT related plant closures, respectively, for a total employment displacement of 8,225. The annual payroll associated with those jobs totals $42.2 million.

Table VII-19. Percent of existing plants with profit levels sufficient to warrant replacement investment, before and after imposition of NSPS limitations

Plant Type	Percent of Plants Before NSPS	Percent of Plants After NSPS
Young chicken		
Small	0	0
Medium	5	0
Large	10	0
Very Large	20	3
Fowl	10	2
Turkey		
Small	0	0
Medium	5	0
Large	20	10
Duck	6	0
Further Processing	15	10
Further Processing with Slaughter	10	5
Total Industry	5	1

Table VII-20. Estimated direct employment impact resulting from plant closures 1/ 2/.

Plant Type	Jobs Eliminated			Payroll Reduction		
	BPT	BAT	BPT & BAT	BPT	BAT	BPT & BAT
				($ million)		
Young chicken						
Small	1,550	2,775	3,725	7.9	11.1	19.0
Medium	625	1,250	1,875	3.2	6.4	9.6
Large	325	325	650	1.7	1.7	3.4
Very Large	0	0	0	0	0	0
Total	2,500	3,750	6,250	12.8	19.2	32.0
Fowl						
Total	200	300	500	1.0	1.5	2.5
Turkey						
Small	450	700	1,150	2.3	3.6	5.9
Medium	225	0	225	1.2	0	1.2
Large	0	0	0	0	0	0
Total	675	700	1,375	3.5	3.6	7.1
Duck						
Total	50	50	100	0.3	0.3	0.6
Further Processing						
Total	0	0	0	0	0	0
Total Industry	3,425	4,800	8,225	17.6	24.6	42.2

1/ Includes both direct and indirect labor.

2/ Summation of components may not equal totals due to rounding.

The probability of those workers securing jobs in other poultry processing plants is rather low for three reasons: (1) the geographic dispersion of plants may place the next closest plant beyond a reasonable driving distance (2) an increase in capacity utilization in the remaining plants can be achieved with a very modest increase in labor requirements and (3) new poultry processing plants may not be located in the same communities impacted by plant closures. However, a small percentage of the workers should be able to find jobs within the poultry processing industry.

For those workers unable to find re-employment in the industry, finding new employment will be difficult in most cases. The workers are generally of a low skill level as indicated by the low salaries existing in the industry. The salary levels also suggest that the workers' employment opportunities are quite limited (e.g. the salary level in the red meat processing industry is roughly double that of the poultry processing industry). Finally, as stated in Chapter I, many of the plants are located in small communities. The labor markets in these areas are typically weak under normal circumstances and the closure of a major employer in the area would intensify the problem.

On the brighter side, some new employment would be created in communities where new plant construction is focused. To a large extent, the new jobs plus re-employment in existing plants should offset the losses in employment to a large extent. Still, however, the problem of spatial employment dislocations would be present.

To the extent that new plants were moved to other production areas, the plant closures would also impact employment in the other sectors of the poultry industry. Since the industry is characterized by a high level of vertical integration, contract growers in marginal production areas would be faced with a loss of their production contracts and no alternative markets for their output. Also, many of the growers could not stay in business without the financial and technical assistance provided by the integrator. In some cases a hatchery, feed mill, etc., might also be closed if the processing plant could not be maintained.

E. Community Effects

Since a high proportion of the industry's plants are located in small communities (see Table I-18, Chapter I), their closure would have a noticeable impact on the community and its surrounding area. For example, the closure of a medium plant in the young chicken subsegment would mean a reduction in production worker payroll of nearly $1 million. That would not include the salaries of those workers falling in the indirect labor class. By the time indirect labor is included, the loss of a medium young chicken plant could reduce the total payroll of a city of 25,000 by nearly 2 percent (based on 8,000 employed workers earning $8,000 each). For a town of 5,000 the figure would jump to 10 percent with a corresponding reduction in the economic base of the community.

In addition to the direct loss of payrolls, the loss in purchases of utilities, transportation services, office supplies and other items by the plant would be felt throughout the community. By the time second and third round multiplier effects are considered (in the neighborhood of 2.5 times the direct payroll loss), the impact would be overwhelming to many small communities.

It is impossible to precisely determine the communities in which poultry processing plants would close. However, as indicated, a high proportion of these plants are in relatively small communities. Few communities have more than one poultry processing plant and, therefore, we conclude that the number of communities impacted will approximate the number of plant closures.

F. Balance of Trade Effects

The poultry industry has been actively engaged in expanding exports of processed poultry. To a certain extent these efforts have been rewarding. Exports of broilers and turkeys totalled 93.8 and 49.7 million pounds, respectively, in 1973. Exports are viewed as an opportunity for added growth in the industry even though the import policies of foreign countries have and no doubt will continue to provide a myriad of difficult problems.

Since we have concluded that pollution abatement requirements will not significantly impact total industry production or prices in the long run, we must reach the same conclusion with regard to balance of trade.

VIII. LIMITS OF THE ANALYSIS

A. General Accuracy

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

Detailed 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 industry, published financial performance data and discussions with equipment manufacturers and other knowledgeable individuals.

Published information from the Internal Revenue Service, Standard and Poors, Dun and Bradstreet, Robert Morris Associates, 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.

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 "typical" processing plants as described in Chapter VI and Appendix A of this report. It was necessary to adapt these costs to the types and sizes of model plants used in this analysis. These data are critical to the impact analysis and 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 poultry meat processing 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 industry	± 10
5.	Salvage values of plants and equipment	± 20
6.	Effluent treatment costs	
	a. For a specific plant	- 50 to + 100
	b. For the average overall plants	± 25

2. Errors in Plant Closure Estimates - In Chapter VII, 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 highly unlikely.

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

1. 10 Percent fewer plants would be direct discharges
2. 10 Percent fewer plants would be small
3. Profits would be 25 percent higher than those used in the analysis
4. Plant salvage values would be 20 percent lower than those used in the analysis
5. Estimated effluent treatment costs would be too high by 25 percent
6. Capital availability would not be a determining factor
7. Cost of capital would be 8 percent rather than 10 percent

Under the best possible conditions, plant closures would probably be reduced by 50 - 75 percent.

If this best possible situation were coupled with the ability of large plants to recover pollution abatement costs via increased product prices, plant closures would be reduced by 75-100 percent.

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

1. 10 Percent more plants would be direct discharges
2. 10 Percent more plants would be small
3. Profits would be 25 percent lower than those used in the analysis
4. Plant salvage values would be 20 percent higher than those used in the analysis
5. Effluent treatment costs would be too low by 25 percent
6. 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)
7. Cost of capital would be 12 percent instead of 10 percent

Under these worst possible conditions, we would feel BPT closures would fall about half way between the BPT and BAT closures presented in Chapter VII while BAT closures would be increased by a factor of 2.5 to 2.75.

C. Critical Assumptions

The complex of types and sizes of poultry meat processing 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 within manageable limits and to specify "representative" situations which would permit estimation 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 wastewater treatment costs for plants connected to municipal sewers
6. Assumptions concerning the salvage value of plants and equipment
7. Assumptions concerning "shutdown" decisions

1. Industry structure - The poultry processing industry is both large and complex in its organization. A critical factor affecting the analysis is the number and size of plants. Data are not available on volume of slaughter in non-Federally inspected plants. It was assumed that all of these non-Federally inspected plants would fall into the small category. It is believed that, with few exceptions, this assumption is correct. The assumed number of plants in the further processing segment cannot be verified with published data.

2. Price assumptions - Where possible prices were based on published prices, from U.S.D.A. 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 poultry processing industry. Model plants were constructed to represent median conditions as closely as possible given the available data. Where practical, alternative plant sizes were modeled to reflect economies of scale in effluent treatment as well as processing operations.

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.

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

a. Their segmentation of the industry according to effluent characteristics permits an adequate classification of the industry for the purpose of differentiating economic impacts of water pollution control costs.

b. EPA presented the costs of effluent control as incremental costs. It is assumed that the baseline treatment configuration is representative of current industry treatment practices.

c. Wastewater treatment costs, as provided by EPA, were not consistent with our model plants. It was necessary to develop basic wastewater flow/cost relationships for the proposed guidelines and standards. 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 considered. Cost curves were developed and estimates of investment and annual costs were made for the model plants defined in this report. It is assumed that the resultant cost estimates are representative.

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 and adjusted these costs (where necessary) insofar as possible to the types and sizes of plants analyzed in this report.

e. The costs provided by North Star and EPA do not provide for effluent monitoring. If monitoring is required, it is

assumed that the incremental impact associated with the added costs will be minimal.

5. Municipal wastewater treatment charges - Since well over half of the industry is served by publicly owned wastewater treatment systems, an assumption concerning wastewater treatment costs for plants discharging into municipal sewers was both necessary and critical in the analysis. In the absence of definitive data concerning current and future municipal wastewater treatment charges, and at EPA's suggestion, it was assumed that municipal charges will remain at current levels and that those charges are roughly equivalent to private baseline treatment costs.

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 analytical 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 current value
b. Buildings and equipment were salvaged at a net amount equivalent to 20 and 10 percent of their 1972 replacement values, respectively
c. Net operating capital was recovered intact

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

The methodology required assumptions relative to numerous factors. These assumptions are described in detail in Chapter V and, in some cases, Chapter VII of this report. Assumptions used, while arbitrary, were made in accordance with estimates of conditions prevailing in the poultry meat processing industry.

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APPENDIX A

Cost of Effluent Treatment Data Provided by the Environmental Protection Agency

Appendix A

The data presented in Appendix Tables A-1 through A-3 were provided by the Environmental Protection Agency for use in this report. The data represent a portion of a comprehensive draft report prepared for EPA by the North Star Research Institute. [1/] Appendix Table A-4 was provided by North Star Research Institute in clarification of investment requirements for the irrigation treatment strategy.

[1/] Reid, R. J., et al., Draft Development Document for Effluent Limitations Guidelines and Standards of Performance for the Poultry Processing Industry, Prepared by North Star Research Institute for the United States Environmental Protection Agency under Contract Number 68-01-0593, May, 1974.

Appendix Table A-1. Typical Plant Operating Parameters Used for Estimating Cost of Meeting Effluent Limitations

Plant Type	Production Birds/Day	Waste Water Volume	
		MM liters/day	MGD
Chicken			
Small	51,000	1.794	0.474
Medium	95,000	3.38	0.893
Large	207,000	7.80	2.05
Turkey	12,000	1.30	0.342
Fowl			
Small	26,400	0.964	0.255
Large	65,000	2.37	0.627
Duck			
Small	3,000	0.272	0.072
Large	12,000	1.10	0.288
Further Processing Only	kg (lb) FP/Day		
Small	21,000 (47,000)	0.265	0.070
Large	77,000 (170,000)	0.965	0.255

Appendix Table A-2. Additional Investment Cost for "Typical" Plants in Each Subcategory to Implement Each Indicated Level of Treatment, No Previous Expenditure Included */

Plant Type	1977 Limitations	1983 Limitations	New Source Standards	Irrigation
Chicken				
Small	$ 137,000	$ 171,200	$470,000	$183,000
Medium	172,000	217,000	640,000	323,000
Large	244,000	357,000	950,000	687,000
Turkey	126,000	146,000	400,000	138,000
Fowl				
Small	119,000	138,000	364,000	105,000
Large	154,000	183,000	539,000	235,000
Duck				
Small	89,000	104,000	227,000	35,000
Large	124,000	142,000	385,000	118,000
Further Processing Only				
Small	88,000	102,000	225,000	34,000
Large	119,000	138,000	364,000	105,000
Total Industry Cost	$13,874,000	$15,568,000	--	--

*/ Costs include land where needed.

Appendix Table A-3. Addition to the Total Annual Cost and Operating* Cost for a Plant in Each Subcategory to Operate Treatment System as Described

Plant Type	1977		1983		New Source		Irrigation	
	Operating	Annual	Operating	Annual	Operating	Annual	Operating	Annual
Chicken								
Small	$22,450	$49,850	$ 42,390	$104,030	$54,000	$148,000	$29,800	$66,400
Medium	26,800	61,200	57,060	155,626	67,100	195,100	35,000	99,600
Large	35,200	84,000	96,840	217,000	90,400	280,400	46,000	183,400
Turkey	20,700	45,900	36,540	91,020	48,300	128,300	27,700	55,300
Fowl								
Small	19,800	43,600	33,600	85,080	45,400	118,200	26,250	47,250
Large	24,600	55,400	47,500	114,940	59,700	167,500	32,000	79,000
Duck								
Small	16,450	34,250	25,116	63,636	35,300	80,700	22,900	29,900
Large	20,000	44,800	66,876	119,996	46,400	123,400	26,600	50,200
Further Processing Only								
Small	16,400	34,000	24,930	63,010	35,100	80,100	22,900	29,700
Large	19,800	43,600	33,540	85,020	45,400	118,200	26,200	47,200

*Total annual cost includes operating cost plus capital cost and depreciation in dollars per year. Total operating cost includes manpower and burden, supplies, chemicals, power, taxes, and insurance in dollars per year.

Appendix Table A-4. Land required for using irrigation as a treatment strategy

Plant type	Land required	
	Acres	Investment cost
Chicken		
Small	83.0	$ 83,000
Medium	155.0	155,000
Large	357.0	357,000
Turkey	60.0	60,000
Fowl		
Small	44.0	44,000
Large	109.0	109,000
Duck		
Small	12.5	12,500
Large	50.0	50,000
Further processing only		
Small	12.5	12,500
Large	44.0	44,000

Source: Telephone discussion with R. J. Reid, North Star Research Institute, Minneapolis, Minnesota.

APPENDIX B

Calculations of Cash Flows Used In Discounted Cash Flow (DCF) Analysis

APPENDIX B

The tables contained in this appendix present the data utilized to obtain the model plant net present values reported in Chapter VII of this report. Tables B-1 through B-3 report the baseline cash flows while the remaining tables present the incremental cash outflow resulting from proposed effluent limitation guidelines and standards. As explained below, the data differ from accounting cash flows as presented in Chapter III and, hence, have been referenced as DCF cash flows to avoid possible confusion.

The DCF cash flows differ from accounting cash flows in two respects: (1) before tax profit and income taxes are calculated without regard to interest expenses (i.e. any interest expense in the profit and loss statement is deleted prior to calculating net profit) and (2) a reinvestment allowance equalling 66 percent of depreciation is subtracted from the cash flow. The first step is necessary to conform with the after tax cost of capital figure used as the discount factor. In other words, the discount factor already reflects both interest charges and the income tax effects of those charges. To include interest explicitly in the cash flows would, therefore, result in double accounting. The reinvestment allowance is provided to reflect repayment of long term debt and/or replacement of worn out equipment. The allowance is intended to allow only for maintenance of the current productivity/efficiency level and falls considerably below the industry's current reinvestment of nearly 200 percent of depreciation.

All model plants were treated as single unit corporate entities with respect to income tax calculations. Hence, taxes were calculated as 22 percent of the first $25,000 profit and 48 percent thereafter.

Appendix Table B-1. Annual baseline DCF cash flow for model chicken plants

	Small	Medium	Large	Very Large
	$1,000			
1. Before tax profit	76	202	342	522
2. Interest	21	43	69	97
3. Adjusted before tax profit (1+2)	97	245	411	619
4. Taxes (on 3 above)	40	111	191	291
5. Adjusted after-tax profit	57	134	220	328
6. Depreciation	42	67	98	119
7. Reinvestment	28	44	65	79
8. Baseline DCF (5+6-7)	71	157	253	368

Appendix Table B-2. Annual baseline DCF cash flow for model turkey plants

	Small	Medium	Large
	----------$1,000----------		
1. Before tax profit	103	293	582
2. Interest	20	40	67
3. Adjusted before tax profit	123	333	649
4. Taxes	53	153	305
5. Adjusted after tax profit	70	180	344
6. Depreciation	67	99	127
7. Reinvestment (66% of 6)	44	65	84
8. Baseline DCF (5+6-7)	93	214	387

Appendix Table B-3. Annual baseline DCF cash flow for model duck, fowl and further processing plants

	Ducks	Fowl	Further processing
	$1,000		
1. Before tax profits	166	130	233
2. Interest	39	25	40
3. Adjusted before tax profit	205	155	273
4. Taxes	92	68	125
5. Adjusted after tax profit	113	87	148
6. Depreciation	81	59	93
7. Reinvestment (66% of 6)	53	39	61
8. Baseline DCF (5+6-7)	141	107	180

Appendix Table B-4. Incremental BPT DCF cash flow for model chicken plants

	Small	Medium	Large	Very Large
		($1,000)		
1. Tax on baseline DCF cash flow	40	111	191	291
2. Baseline before tax profit	97	245	411	619
3. BPT operating cost	19	22	25	28
4. BPT depreciation	11	14	16	18
5. BPT before tax profit (2-3-4)	67	209	370	573
6. Tax on BPT DCF cash flow	26	94	171	269
7. BPT after tax profit (5-6)	41	115	199	304
8. Tax reduction (1-6)	14	17	20	22
9. Reinvestment (66% of 4)	7	9	11	12
10. BPT Incremental DCF cash flow (8-3-9)	-12	-14	-16	-17

Appendix Table B-5. Incremental BPT DCF cash flow for model turkey plants

	Small	Medium	Large
		($1,000)	
1. Tax on baseline DCF cash flow	53	153	305
2. Baseline before tax profit	123	333	649
3. BPT operating cost	19	22	25
4. BPT depreciation (10% invest.)	11	13	16
5. BPT before tax profit (2-3-4)	93	298	608
6. Tax on BPT DCF cash flow	38	137	285
7. BPT after tax profit (5-6)	55	161	323
8. Tax reduction (1-6)	15	16	20
9. Reinvestment (66% of 4)	7	9	11
10. BPT incremental DCF cash flow (8-3-9)	-11	-15	-16

Appendix Table B-6. Incremental BPT DCF cash flow for model fowl and duck plants

	Fowl	Ducks
1. Tax on baseline DCF cash flow	68	92
2. Baseline before tax profit	155	205
3. BPT operating cost	21	20
4. BPT depreciation (10% of invest.)	13	12
5. BPT before tax profit (2-3-4)	121	173
6. Tax on BPT DCF cash flow	52	77
7. BPT after tax profit (5-6)	69	96
8. Tax reduction (1-6)	16	15
9. Reinvestment (66% of 4)	9	8
10. BPT incremental DCF cash flow (8-3-9)	-14	-13

Appendix Table B-7. Incremental BPT, DCF cash flow for model further processing plants

	Further Processing ($1,000)
1. Tax on baseline DCF cash flow	125
2. Baseline before tax profit	273
3. BPT operating cost	17
4. BPT depreciation (10% of investment)	9
5. BPT before tax profit (2-3-4)	247
6. Tax on BPT DCF cash flow	112
7. BPT after tax profit (5-6)	135
8. Tax reduction (1-6)	13
9. Reinvestment (66% of 4)	6
10. BPT incremental DCF cash flow (8-3-9)	-10

Appendix Table B-8. Incremental BAT DCF cash flow for model chicken plants

	Small	Medium	Large	Very Large
		($1,000)		
1. Tax on BPT DCF cash flow	26	94	171	269
2. BPT before tax profit	67	209	370	573
3. BAT operating cost	32	41	52	63
4. BAT depreciation (10% invest.)	13	16	20	25
5. BAT before tax profit (2-3-4)	22	152	298	485
6. Tax on BAT DCF cash flow	5	66	137	226
7. BAT after tax profit (5-6)	17	86	161	259
8. Tax reduction (1-6)	21	28	34	43
9. Reinvestment (66% of 4)	9	11	13	17
10. BAT incremental DCF cash flow (8-3-9)	-20	-24	-31	-37

Appendix Table B-9. Incremental BAT DCF cash flow for model turkey plants

	Small	Medium ($1,000)	Large
1. Tax on BPT DCF cash flow	38	137	285
2. BPT before tax profit	93	298	608
3. BAT operating cost	31	40	50
4. BAT depreciation (10% invest.)	12	16	20
5. BAT before tax profit (2-3-4)	50	242	538
6. Tax on BAT DCF cash flow	18	110	252
7. BAT after tax profit (5-6)	32	132	286
8. Tax reduction (1-6)	20	27	33
9. Reinvestment (66% of 4)	8	11	13
10. BAT incremental DCF cash flow (8-3-9)	-19	-24	-30

Appendix Table B-10. Incremental BAT DCF cash flow for model duck and fowl plants

	Ducks	Fowl
	($1,000)	
1. Tax on BPT DCF cash flow	77	52
2. BPT before tax profit	173	121
3. BAT operating cost	34	38
4. BAT depreciation (10% of invest.)	14	15
5. BAT before tax profit (2-3-4)	125	68
6. Tax on BAT DCF cash flow	54	26
7. BAT after tax profit (5-6)	71	42
8. Tax reduction (1-6)	23	26
9. Reinvestment (66% of 4)	9	10
10. BAT incremental DCF cash flow (8-3-9)	-20	-22

Appendix Table B-11. Incremental BAT, DCF cash flow for model further processing plants

	Further Processing ($1,000)
1. Tax on BPT DCF cash flow	112
2. BPT before tax profit	247
3. BAT operating cost	26
4. BAT depreciation (10% of investment)	10
5. BAT before tax profit (2-3-4)	211
6. Tax on BAT DCF cash flow	95
7. BAT after tax profit (5-6)	116
8. Tax reduction (1-6)	17
9. Reinvestment (66% of 4)	7
10. BAT incremental DCF cash flow (8-3-9)	-16

Appendix Table B-12. Incremental irrigation DCF cash flow for model chicken plants

	Small	Medium	Large	Very Large
	$1,000			
1. Tax on baseline DCF cash flow	40	111	191	291
2. Baseline before tax profit	97	245	411	619
3. Irrigation operating cost	25	29	33	37
4. Irrigation depreciation (10% invest.)	5	10	15	19
5. Irrigation before tax profit (2-3-4)	67	206	363	563
6. Tax on irrigation DCF cash flow	26	92	168	264
7. Irrigation after tax profit (5-6)	41	114	195	299
8. Tax reduction (1-6)	14	19	23	27
9. Reinvestment (66% of 4)	3	7	10	13
10. Irrigation incremental DCF cash flow (8-3-9)	-14	-17	-20	-23

Appendix Table B-13. Incremental irrigation DCF cash flow for model turkey plants

	Small	Medium	Large
	----------$1,000----------		
1. Tax on baseline DCF cash flow	53	153	305
2. Baseline before tax profit	123	333	649
3. Irrigation operating cost	25	39	33
4. Irrigation depreciation (10% invest.)	4	9	14
5. Irrigation before tax profit (2-3-4)	94	295	602
6. Tax on irrigation DCF cash flow	39	135	282
7. Irrigation after tax profit (5-6)	55	160	320
8. Tax reduction (1-6)	14	18	23
9. Reinvestment (66% of 4)	3	6	9
10. Irrigation Incremental DCF cash flow (8-3-9)	-14	-17	-19

Appendix Table B-14. Incremental irrigation DCF cash flow for model duck and fowl plants

	Fowl	Ducks
	($1,000)	
1. Tax on baseline DCF cash flow	68	92
2. Baseline before tax profit	155	205
3. Irrigation operating cost	28	26
4. Irrigation depreciation (10% of invest.)	8	6
5. Irrigation before tax profit (2-3-4)	119	173
6. Tax on irrigation DCF cash flow	51	77
7. Irrigation after tax profit (5-6)	68	96
8. Tax reduction (1-6)	17	15
9. Reinvestment (66% of 4)	5	4
10. Irrigation incremental DCF cash flow (8-3-9)	-16	-15

Appendix Table B-15. Incremental irrigation DCF cash flow for model further processing plants

		Further Processing ($1,000)
1.	Tax on baseline DCF cash flow	125
2.	Baseline before tax profit	273
3.	Irrigation operating cost	23
4.	Irrigation depreciation (10% of investment)	2
5.	Irrigation before tax profit (2-3-4)	248
6.	Tax on irrigation DCF cash flow	113
7.	Irrgation after tax profit (5-6)	135
8.	Tax reduction (1-6)	12
9.	Reinvestment (66% of 4)	2
10.	Irrigation incremental DCF cash flow (8-3-9)	-13

Appendix Table B-16. Incremental NSPS DCF cash flow for model chicken plants

	Small	Medium	Large	Very Large
		($1,000)		
1. Tax on baseline DCF cash flow	40	111	191	291
2. Baseline before tax profit	97	245	411	619
3. NSPS operating cost	43	53	62	71
4. NSPS depreciation (10% invest.)	34	47	58	69
5. NSPS before tax profit (2-3-4)	20	145	291	479
6. Tax on NSPS DCF cash flow	4	63	133	223
7. NSPS after tax profit (5-6)	16	82	158	256
8. Tax reduction (1-6)	36	48	58	68
9. Reinvestment (66% of 4)	22	31	38	46
10. NSPS incremental DCF cash flow (8-3-9)	-29	-36	-42	-49

Appendix Table B-17. Incremental NSPS DCF cash flow for model turkey plants

	Small	Medium	Large
		($1,000)	
1. Tax on baseline DCF cash flow	53	153	305
2. Baseline before tax profit	123	333	649
3. NSPS operating cost	42	51	61
4. NSPS depreciation (10% invest.)	33	45	56
5. NSPS before tax profit (2-3-4)	48	237	532
6. Tax on NSPS DCF cash flow	17	107	249
7. NSPS after tax profit (5-6)	31	130	283
8. Tax reduction (1-6)	36	46	56
9. Reinvestment (66% of 4)	22	30	37
10. NSPS incremental DCF cash flow (8-3-9)	-28	-35	-42

Appendix Table B-18. Incremental NSPS DCF cash flow for model duck and fowl plants

	Ducks	Fowl
	($1,000)	
1. Tax on baseline DCF cash flow	92	68
2. Baseline before tax profit	205	155
3. NSPS operating cost	45	50
4. NSPS depreciation (10% of invest.)	37	43
5. NSPS before tax profit (2-3-4)	123	62
6. Tax on NSPS DCF cash flow	53	23
7. NSPS after tax profit (5-6)	70	39
8. Tax reduction (1-6)	39	45
9. Reinvestment (66% of 4)	24	28
10. NSPS incremental DCF cash flow (8-3-9)	-30	-33

Appendix Table B-19. Incremental NSPS, DCF cash flow for model further processing plants

	Further Processing ($1,000)
1. Tax on baseline DCF cash flow	125
2. Baseline before tax profit	273
3. NSPS operating cost	36
4. NSPS depreciation (10% of investment)	24
5. NSPS before tax profit (2-3-4)	213
6. Tax on NSPS DCF cash flow	96
7. NSPS after tax profit (5-6)	117
8. Tax reduction (1-6)	29
9. Reinvestment (66% of 4)	16
10. NSPS incremental DCF cash flow (8-3-9)	-23