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Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry

Final

NESHAP

RTI Project Number 5428-33 DR

Economic Analysis of Air Pollution Regulations: Dry Cleaning Industry

Emission Standards Division

U.S. Environmental Protection Agency
Office of Air and Radiation
Office of Air Quality Planning and Standards
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SECTION 1
INTRODUCTION

Under the Clean Air Act of 1990, the U.S. Environmental Protection Agency (EPA) is required to propose and promulgate National Emission Standards for Hazardous Air Pollutants (NESHAP). In keeping with this requirement, the EPA proposed a standard to control perchloroethylene (PCE) air emissions from dry cleaning facilities on December 9, 1991. The purpose of this analysis is to evaluate the impacts of the final NESHAP for promulgation (referred to as final standards or standards in the balance of this report).

The economic and financial impacts of the regulatory alternatives considered for proposal were estimated in the Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry (EPA, 1991). A copy of the 1991 report appears in Appendix A of this report. This report follows the same methodology and assumptions included in EPA's 1991 report.

Public comments in response to the proposed NESHAP raised several issues, including concerns about possible air and water quality impacts associated with carbon adsorber (CA) control devices and about the use of additional controls designed to reduce fugitive emissions from transfer machines. The final standards evaluated in this report reflect EPA's response to these issues. Furthermore, the impacts reported in this analysis include recordkeeping costs, which were not included in the impacts reported in Appendix A.

The standards outlined in this analysis will potentially affect dry cleaners in two industry sectors: commercial dry cleaners (SIC 7216) and industrial dry cleaners (SIC 7218). Coin-operated facilities (SIC 7215) are not included in this analysis because no facilities in this sector are projected to incur impacts. Commercial facilities are the most prevalent type of dry cleaners and are generally located in shopping centers and near densely populated areas. Industrial plants usually rent uniforms and other items to their industrial or commercial users and are generally larger than commercial and coin-operated facilities. Appendix A contains a profile of the affected industry sectors.

This section provides an overview of the proposed standards, a description of the requirements of the final standards, and a summary of the impacts of the final standards. Section 2 contains the estimated costs of the control requirements and describes the methods used to project owners' responses to these control costs. Sections 3 and 4 describe the methods used to compute economic and financial impacts of the standards; these sections also report the results of the analysis.

1.1 REQUIREMENTS AND IMPACTS OF THE PROPOSED STANDARDS

Under the proposed standards all existing facilities with greater than $100,000 in annual receipts are required to install vent controls to limit PCE emissions. Control equipment requirements under the proposed standards vary with the industry sector and machine technology. These control requirements are shown in Table 1-1. (See Appendix A for a description of the machine technologies identified in Table 1-1.)

The projected price and output adjustments, welfare impacts, and plant closures due to the proposed standards are shown in Table 1-2. The methods and assumptions used to compute these impacts are described in Appendix A. The price and output adjustments are short-run effects. Almost all new dry cleaning machines are equipped with built-in vent controls that satisfy the requirements of the proposed standards. The current stock of uncontrolled machines would have been replaced with controlled machines even in the baseline. Consequently, long-run price and output adjustments are zero.

The producer and consumer welfare costs reported in Table 1-2 are projected for the first year of the regulation. Fewer losses will be incurred in 14 subsequent years as a result of replacing

TABLE 1-1. CONTROL TECHNOLOGY REQUIREMENTS UNDER THE PROPOSED STANDARDS BY INDUSTRY SECTOR AND MACHINE TYPE

Industry Sector and Machine Type	Control Technology Requirement
Commercial	
Dry-to-Dry	CA or Refrigerated Condenser (RC)
Transfer (uncontrolled)	CA
Transfer (RC controlled)	No additional control required
Industrial	
Dry-to-Dry	CA or RC
Transfer	CA

Source: U.S. Environmental Protection Agency. 1991. Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry. Final report prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA 450/3-91-021.

existing uncontrolled machines with controlled machines, even at baseline. Fifteen years after the regulation takes effect, producer and consumer welfare costs are zero, assuming that the current stock of uncontrolled machines is replaced with controlled machines in the baseline over this time period. The plant closure projections assume that the short-run industry output reductions are achieved by closing the smallest affected facilities.

The estimated regulatory costs of the proposed standards result in short-run price and output adjustments that are relatively small (less than one percent in absolute value). The estimated loss in consumer welfare is $6.7 million for the commercial sector. Producers in the commercial sector lose an estimated $4.8 million in welfare. Note that these welfare losses only consider the costs of controlling emissions. The benefits associated with changes in environmental quality are not included

TABLE 1-2. ECONOMIC IMPACTS OF PROPOSED NESHAP[a]

Industry Sector and Model Market	Price Adjustment (%)	Output Adjustment (%)	Consumer Welfare Impacts[b] ($\$10^3$)	Producer Welfare Impacts[b] ($\$10^3$)	Net Welfare Impacts ($\$10^3$)	Plant Closures[c] (Number)
Commercial						
A	0	0	0	0	0	0
B	0	0	0	0	0	0
C	0	0	0	0	0	0
D	0	0	0	-389	-389	0
E	0.33	-0.36	-3,240	-2,270	-5,500	14
F	0.37	-0.41	-3,440	-2,410	-5,860	14
Total	d	-0.20	-6,680	-5,070	-11,700	28
Industrial	0	0	0	274	274	0

Source: U.S. Environmental Protection Agency. 1991. Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry. Final report prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA 450/3-91-021.

[a]The coin-operated sector is not included in this table because no facilities in this sector are projected to incur impacts under the proposed NESHAP because of the size cutoff.

[b]Producer and consumer welfare losses incurred in first year of regulation. Costs will be incurred in subsequent years but will decline over time. Recurring annual costs will be zero 15 years after the effective date of the regulation assuming that the current stock of uncontrolled machines would be replaced by dry-to-dry machines in the baseline over this time period.

[c]Net plant closures assuming all industry output reductions are achieved by closures of smallest affected facilities.

[d]Average price impacts for the entire commercial sector are not reported in this table because the average impact underestimates price adjustments for markets where affected facilities dominate and overestimates adjustments with no affected or very few affected facilities.

in the estimates of welfare impacts. Under the proposed standards, 28 plant closures are projected for the commercial sector.

The output reduction shown in Table 1-2 was used to project worker displacements resulting from the proposed standards. The projected worker displacements assume that layoffs are proportional to the short-run industry output reductions. Under the proposed standards, it is projected that 354 workers will be displaced. The projected worker displacement costs are based on the projected displacements and are one-time (nonrecurring) costs. Under the proposed standards, projected worker displacement costs total $10.2 million. Implicit in the estimated displacement costs is the assumption that this baseline output reduction--and the corresponding reduction in employment--would have been accounted for through attrition rather than through worker dislocation. In other words, the present value of foregone future displacement is assumed to be zero.

In addition to the economic impacts, EPA estimated financial impacts due to the proposed standards under two financial scenarios: Financial Scenario I, which assumes a positive relationship between firm size and baseline firm financial condition and Financial Scenario II, which assumes that the number of firms in below-average, average, and above-average baseline financial condition is proportionately distributed across firms of all sizes. The firm financial analysis used the costs estimated for the economic impact analysis to project changes in the financial viability of affected dry cleaning firms. Under Financial Scenario I, no changes in ownership are projected. Under Financial Scenario II, 669 changes in ownership are projected because of capital availability constraints.

1.2 REQUIREMENTS OF THE FINAL STANDARDS

Three categories of requirements contained in the final standards were evaluated for this analysis: vent control requirements, room enclosure requirements, and recordkeeping requirements. The control requirements vary by industry sector, type of dry cleaning machine, level of output, baseline vent control device, and designation as a major or area source. Major sources include facilities emitting 10 or more tons of PCE per year; area sources include facilities emitting less than 10 tons of PCE per year. For this analysis, it was assumed that major sources include all industrial facilities and commercial facilities with greater than $100,000 in annual receipts that operate uncontrolled transfer machines.

Table 1-3 contains the control technology requirements for dry cleaning machines under the final standards. All dry-to-dry and transfer machines at facilities with output levels corresponding to more than $75,000 in annual receipts are subject to vent control and recordkeeping requirements. The vent control requirements specify that uncontrolled facilities install RCs. Facilities above $75,000 that use CA control devices in the baseline are not required to purchase and install RC control devices until their CA requires replacement.

Room enclosure requirements apply only to major sources that use transfer machines or reclaimers (dryer used in combination with a transfer washer or dry-to-dry machine). In this analysis, it was assumed that room enclosures are required for all industrial dry cleaners with transfer machines and for commercial facilities over $100,000 in receipts operating transfer machines without baseline control devices. Room enclosure requirements include a small CA (approximately one-third the size of a CA used for process vent controls) to capture and control fugitive emissions from transfer machines.

The control requirements contained in Table 1-3 are for existing dry cleaning machines. New dry-to-dry machines are subject to the same requirements (including RC vent controls and recordkeeping) as existing dry-to-dry machines with one exception:

TABLE 1-3. REQUIREMENTS OF THE FINAL STANDARDS

Industry Sector and Machine Technology	Baseline Vent Control	Under $75K Annual Receipts			$75 to $100K Annual Receipts			Over $100K Annual Receipts		
		RC	RE	RK	RC	RE	RK	RC	RE	RK
Commercial										
Dry-to-Dry	No			√	√		√	√		√
Dry-to-Dry	Yes			√			√			√
Transfer	No			√	√		√	√	√	√
Transfer	Yes			√			√			√
Industrial										
Dry-to-Dry	No	--	--	--	--	--	--	√		√
Dry-to-Dry	Yes	--	--	--	--	--	--			√
Transfer	No	--	--	--	--	--	--	√	√	√
Transfer	Yes	--	--	--	--	--	--		√	√

Notes:

1. Facilities over $75,000 in annual receipts with baseline vent controls are required to purchase and install an RC when their current vent control device requires replacement.
2. The RE requirement includes a small CA to capture the fugitive emissions released during clothing transfer.
3. In this analysis, it is assumed that all industrial facilities are over $100,000 in annual receipts.

Key to Abbreviated Terms:

RC = Refrigerated Condenser
RE = Room Enclosure
RK = Recordkeeping

new dry-to-dry machines at major source facilities are required to install both RC and CA devices. New transfer machines are effectively banned under the final standards through a requirement to emit no emissions during clothing transfer.

1.3 IMPACTS OF THE FINAL STANDARDS

Impacts due to the final standards were projected using an integrated approach that combines an economic impact analysis with a firm financial analysis. The approach was integrated by using inputs from each type of analysis to compute impacts in the other. For example, financial impacts were based on the costs computed in the economic analysis. In turn, economic impacts were based on the costs of capital computed using data on the financial status of firms in the industry.

1.3.1 Economic Impacts

The economic impacts of the standard were computed using a methodological and empirical approach based on the principles of applied microeconomics. Economic impacts were quantified through estimating market adjustments of price and output and estimating corresponding effects on consumer and producer welfare. The effects of the standards on employment and plant closures were also quantified as part of the economic impact analysis. The key elements of the economic analysis are as follows:

- Analyzed impacts using a model plant approach that characterizes machine technology, machine capacity, and operating practices of typical dry cleaning machines. Impacts are measured at multiple capacity utilization levels for each model plant.

- Analyzed impacts using an urban/rural model market approach. Model markets differentiate the market for dry cleaning services by number of facilities in the market, the share of affected and unaffected facilities in the market, the baseline price of dry cleaning services, and the projected behavioral response to regulation.

- Computed annualized compliance costs using engineering data and an estimated weighted average cost of capital (WACC) for firms in below-average, average, and above-average financial condition (consistent with the distribution of financial condition used in Financial Scenario II).

- Estimated short-run price and output adjustments and corresponding consumer and producer welfare impacts using applied microeconomics. (Welfare impacts computed in this analysis consider only the costs of controlling emissions. The benefits associated with changes in environmental quality are not included in the estimates of welfare impacts.)

- Projected net plant closures based on the assumption that the entire reduction in output is accounted for by the smallest affected plants leaving the industry.

- Estimated one-time worker displacements and displacement costs.

The price and output adjustments projected for the final standards are all relatively small (<2.5 percent in absolute value). In the commercial sector the net welfare impacts are an estimated -$25 million. In the industrial sector, a welfare gain of $607,000 is projected. The output reduction in the commercial sector results in an estimated 259 plant closures and -$23.4 million in worker displacement costs.

1.3.2 Financial Impacts

As previously mentioned, the financial analysis of affected dry cleaning firms was based on the costs computed for the economic analysis. Ownership impacts were estimated using financial data on the distribution of firm financial health. The changes in firm financial status and capital availability for firms of different sizes and financial condition were estimated in the financial analysis. Key elements of the financial analysis are as follows:

- Utilized a baseline distribution of commercial dry cleaning firms by financial condition and firm size under two financial scenarios.

- Evaluated the availability of funds to firms of different baseline financial condition and different output levels.

- Evaluated profitability impacts on firms by baseline financial status and baseline output level.

- Projected changes in ownership due to profitability impacts and capital availability constraints.

Projected changes in ownership due to the promulgation requirements all result from capital availability constraints. The estimated number of projected changes in ownership ranges from 0 to 834, depending on the financial scenario.

SECTION 2
OWNERS' RESPONSES TO THE FINAL STANDARDS

Owners of affected facilities have several options for responding to the standards. This section reports the estimated control costs associated with the control requirements of the final standards, characterizes the owners' options for responding to these requirements, and describes the methods used to project the owners' responses.

2.1 CONTROL COSTS

The promulgation requirements evaluated in this report include vent controls, room enclosures, and recordkeeping requirements (see Table 1-3). Affected entities will potentially incur initial and recurring costs as a result of these requirements. Tables 2-1 and 2-2 report the capital (initial) and annual operating (recurring) costs associated with the vent control requirements and room enclosure requirements estimated for facilities with $75,000 or more in annual receipts. Tables 2-3 and 2-4 report the initial and recurring recordkeeping costs for facilities with RC-controlled machines and CA-controlled machines, respectively. Costs reported for recordkeeping requirements include leak detection and repair costs. Costs reported in Tables 2-1 through 2-4 are net of any solvent recovery savings associated with the controls.

2.2 OWNERS' RESPONSES TO CONTROL REQUIREMENTS

The owners of dry cleaning facilities potentially affected by the requirements of the standards may respond in several ways. Owners can invest in the required vent controls and room enclosures, switch solvents, accelerate the purchase of new dry-to-dry machines with built in RCs, or cease operations. These owners must evaluate their alternatives, assess the benefits and costs of each, and respond in some manner. Owners generally respond in the way that maximizes the net-present value of the firm.

TABLE 2-1. CAPITAL COSTS OF CONTROL: VENT CONTROLS AND ROOM ENCLOSURES ($/facility/yr)

Industry Sector and Machine Capacity (kg/load)	Machine Technology	$75 to $100K Annual Receipts			Over $100K Annual Receipts		
		RC	RE + Small CA	Small CA	RC	RE + Small CA	Small CA
Commercial							
6.8	Dry-to-Dry	6,283	NA	NA	25,132	NA	NA
8.2	Dry-to-Dry	6,283	NA	NA	18,849	NA	NA
11.3	Dry-to-Dry	6,283	NA	NA	18,849	NA	NA
13.6	Dry-to-Dry	6,283	NA	NA	12,566	NA	NA
15.9	Dry-to-Dry	6,283	NA	NA	12,566	NA	NA
15.9	Transfer	8,424	NA	NA	16,848	14,325	2,325
20.4	Dry-to-Dry	6,283	NA	NA	12,566	NA	NA
22.7	Dry-to-Dry	6,283	NA	NA	12,566	NA	NA
22.7	Transfer	8,424	NA	NA	16,848	14,325	2,325
27.2	Dry-to-Dry	6,283	NA	NA	6,283	NA	NA
45.4	Dry-to-Dry	8,675	NA	NA	8,675	NA	NA
45.4	Transfer	10,811	NA	NA	10,811	14,325	2,325
Industrial							
63.5	Dry-to-Dry	--	--	--	20,000	NA	NA
113.4	Dry-to-Dry	--	--	--	20,000	NA	NA
113.4	Transfer	--	--	--	20,000	15,327	3,327

Source:

Radian Corporation. 1990. "National Cost Impacts of Regulatory Alternatives for the Hazardous Air Pollutant Dry Cleaning NESHAP." Memorandum from Carolyn Norris and Kim Kepford to U.S. Environmental Protection Agency, Chemical and Petroleum Branch. January 25.

Note:

1. Operating costs are net of solvent recovery savings. Negative values indicate solvent recovery savings that exceed costs.
2. In this analysis, it is assumed that all industrial facilities have more than $100,000 in annual receipts.

Key to Abbreviated Terms:

RC = refrigerated condenser
RE = room enclosure
CA = carbon adsorber
NA = not applicable

TABLE 2-2. ANNUAL OPERATING COSTS OF CONTROL: VENT CONTROLS AND ROOM ENCLOSURES ($/facility/yr)

Industry Sector and Machine Capacity (kg/load)	Machine Technology	$75 to $100K Annual Receipts			Over $100K Annual Receipts		
		RC	RE + Small CA	Small CA	RC	RE + Small CA	Small CA
Commercial							
6.8	Dry-to-Dry	231	NA	NA	-1,486	NA	NA
8.2	Dry-to-Dry	221	NA	NA	-1,168	NA	NA
11.3	Dry-to-Dry	103	NA	NA	-1,238	NA	NA
13.6	Dry-to-Dry	100	NA	NA	-846	NA	NA
15.9	Dry-to-Dry	98	NA	NA	-861	NA	NA
15.9	Transfer	183	NA	NA	-690	323	NA
20.4	Dry-to-Dry	95	NA	NA	-880	NA	NA
22.7	Dry-to-Dry	93	NA	NA	-887	NA	NA
22.7	Transfer	179	NA	NA	-716	322	NA
27.2	Dry-to-Dry	92	NA	NA	-449	NA	NA
45.4	Dry-to-Dry	184	NA	NA	-363	NA	NA
45.4	Transfer	270	NA	NA	-278	320	941
Industrial							
63.5	Dry-to-Dry	--	--	--	-4,391	NA	760
113.4	Dry-to-Dry	--	--	--	-10,263	NA	466
113.4	Transfer	--	--	--	-10,263	-8,169	466

Source:

Radian Corporation. 1993. "Annual Respondent Burden and Cost of Reporting and Recordkeeping Requirements of the Promulgated Standard." Memorandum from Carolyn Norris to Brenda Jellicorse, Research Triangle Institute, Research Triangle Park, NC. June 2.

Note:

1. Operating costs are net of solvent recovery savings. Negative values indicate solvent recovery savings that exceed costs.
2. In this analysis, it is assumed that all industrial facilities have more than $100,000 in annual receipts.

Key to Abbreviated Terms:

RC = refrigerated condenser
RE = room enclosure
CA = carbon adsorber
NA = not applicable

TABLE 2-3. RECORDKEEPING COSTS FOR RC-CONTROLLED FACILITIES

Industry Sector and Machine Capacity (kg/load)	Machine Technology	Costs for Facilities with $0 to $75K Receipts		Costs for Facilities with $75 to $100K Receipts		Costs for Facilities with Over $100K Receipts	
		Initial	Annual	Initial	Annual	Initial	Annual
Commercial							
6.8	Dry-to-Dry	126	328	169	644	181	1,276
8.2	Dry-to-Dry	126	328	169	644	175	960
11.3	Dry-to-Dry	126	328	163	328	175	960
13.6	Dry-to-Dry	126	328	163	328	169	644
15.9	Dry-to-Dry	126	328	163	328	169	644
15.9	Transfer	126	328	163	328	169	644
20.4	Dry-to-Dry	126	328	163	328	169	644
22.7	Dry-to-Dry	126	328	163	328	169	644
22.7	Transfer	126	328	163	328	169	644
27.2	Dry-to-Dry	126	328	163	328	163	328
45.4	Dry-to-Dry	126	328	163	328	163	328
45.4	Transfer	126	328	163	328	164	337
Industrial							
63.5	Dry-to-Dry	--	--	--	--	164	337
113.4	Dry-to-Dry	--	--	--	--	164	337
113.4	Transfer	--	--	--	--	164	337

Source:

Radian Corporation. 1993. "Annual Respondent Burden and Cost of Reporting and Recordkeeping Requirements of the Promulgated Standard." Memorandum from Carolyn Norris to Brenda Jellicorse, Research Triangle Institute, Research Triangle Park, NC. June 2.

Notes:

1. Costs incurred in the first year of compliance include initial and annual costs. Only the annual costs are incurred in subsequent years.
2. Costs vary by output level (expressed in annual receipts) because of differences in assumptions regarding the number of machines per facility.
3. In this analysis, it is assumed that all industrial facilities have more than $100,000 in annual receipts.

Key to Abbreviated Terms:

RC = refrigerated condenser

TABLE 2-4. RECORDKEEPING COSTS FOR CA-CONTROLLED FACILITIES

Industry Sector and Machine Capacity (kg/load)	Machine Technology	Costs for Facilities with $0 to $75K Receipts		Costs for Facilities with $75 to $100K Receipts		Costs for Facilities with Over $100K Receipts	
		Initial	Annual	Initial	Annual	Initial	Annual
Commercial							
6.8	Dry-to-Dry	126	328	169	802	181	1,592
8.2	Dry-to-Dry	126	328	169	802	175	1,197
11.3	Dry-to-Dry	126	328	163	407	175	1,197
13.6	Dry-to-Dry	126	328	163	407	169	802
15.9	Dry-to-Dry	126	328	163	407	169	802
15.9	Transfer	126	328	163	407	169	802
20.4	Dry-to-Dry	126	328	163	407	169	802
22.7	Dry-to-Dry	126	328	163	407	169	802
22.7	Transfer	126	328	163	407	169	802
27.2	Dry-to-Dry	126	328	163	407	169	802
45.4	Dry-to-Dry	126	328	163	407	163	407
45.4	Transfer	126	328	163	407	163	407
Industrial						164	416
63.5	Dry-to-Dry	--	--	--	--	164	416
113.4	Dry-to-Dry	--	--	--	--	164	416
113.4	Transfer	--	--	--	--	164	416

Source:

Radian Corporation. 1993. "Annual Respondent Burden and Cost of Reporting and Recordkeeping Requirements of the Promulgated Standard." Memorandum from Carolyn Norris to Brenda Jellicorse, Research Triangle Institute, Research Triangle Park, NC. June 2.

Notes:

1. Costs incurred in the first year of compliance include the initial plus annual costs. Only the annual costs are incurred in subsequent years.
2. Costs vary by output level (expressed in annual receipts) because of differences in assumptions regarding the number of machines per facility.
3. Costs presented in this table are for facilities with CA controls in the baseline. Uncontrolled facilities are required to install RCs.
4. In this analysis, it is assumed that all industrial facilities have more than $100,000 in annual receipts.

Key to Abbreviated Terms:

CA = carbon adsorber RC = refrigerated condenser

If the expected costs of operating the plant exceed the expected revenues, the owner(s) of the plant closes it. If the expected revenues of operating the complying plant exceed the expected costs, it is economically viable, so the owner(s) will likely keep the plant or sell it. Owner(s) keep the plant if they have and/or can borrow the funds required for the capital investment. If, however, they neither have nor can borrow the required funds, they may decide to sell the plant. Potential changes in ownership due to capital constraints are discussed in Section 4. The discussion that follows, however, assumes that owner(s) continue operating the plant.

All dry cleaning facilities in the commercial and industrial sectors are required to perform recordkeeping activities. However, owners have several choices for complying with the vent control and room enclosure requirements. The choice that the plant owner(s) makes depends on the sector, the machine type, the level of baseline control, and financial condition of the plant owner(s). Assuming that the owner(s) does not cease operating in response to the standards leaves three basic options for affected entities: (1) invest in the required vent control device (dry-to-dry and transfer) and/or room enclosure (transfer), (2) accelerate the purchase of a new dry-to-dry machine with the required vent controls, or (3) switch solvents. Solvent substitution is not a cost-less option for most dry cleaners for many reasons, including higher solvent prices, differences in the cleaning properties of solvents, and the compatibility (or lack thereof) of alternative solvents with existing equipment. Although other solvents are used in some dry cleaning plants, none are currently considered feasible for widespread substitution for PCE (EPA, 1991). Consequently, solvent substitution is not considered further in this analysis.

Table 2-5 identifies the relevant response options for all facilities required to meet requirements beyond recordkeeping. Facilities required to meet requirements beyond the recordkeeping requirements include the following:

TABLE 2-5. RESPONSE OPTIONS FOR DRY CLEANERS SUBJECT TO REQUIREMENTS BEYOND RECORDKEEPING UNDER THE FINAL STANDARDS

Industry Sector and Machine Technology	Baseline Vent Control	Annual Receipts per Facility	
		$75 to $100K	Over $100K
<u>Commercial</u>			
Dry-to-Dry	None	• RC + RK(RC) • D/D(RC) + RK(RC)	• RC + RK(RC) • D/D(RC) + RK(RC)
Transfer	None	• RC + RK(RC) • D/D(RC) + RK(RC)	• RC + RK(RC) + RE • D/D(RC) + RK(RC)
<u>Industrial</u>			
Dry-to-Dry	None	--	• RC + RK(RC) • D/D(RC + CA) + RK(RC)
Transfer	None	--	• RC + RK(RC) + RE • D/D(RC + CA) + RK(RC)
Transfer	RC	--	• RK(RC) + RE
Transfer	CA	--	• RK(CA) + RE • D/D(RC + CA) + RK(RC)

Notes:

1. For this analysis, it was assumed that no industrial facilities have less than $100,000 in annual receipts.
2. Facilities with less than $75,000 in annual receipts are subject to recordkeeping requirements only. Consequently, these small facilities are not included in this table.

Definition of Terms:

RC	= Purchase and install a refrigerated condenser.
RK(RC)	= Perform recordkeeping activities required for facilities with a refrigerated condenser.
D/D(RC)	= Accelerate the purchase of a new dry-to-dry facility with a built-in refrigerated condenser.
RE	= Build a room enclosure with a small carbon adsorber.
D/D(RC + CA)	= Accelerate the purchase of a new dry-to-dry facility with a built-in refrigerated condenser and install a small carbon adsorber.
RK(CA)	= Perform recordkeeping activities required for facilities with a carbon adsorber.

- commercial facilities with more than \$75,000 in annual receipts that operate uncontrolled dry-to-dry machines,
- commercial facilities with more than \$75,000 in annual receipts that operate uncontrolled transfer machines,
- industrial facilities that operate uncontrolled dry-to-dry machines, and
- industrial facilities that operate either uncontrolled or controlled transfer machines.

For this analysis, it was assumed that owner(s) will select the least costly option in present value terms. The net present cost (NPC) of each available option was computed using data from the control costs presented in Tables 2-1 through 2-4 and the capital costs of a new dry-to-dry machine (reported in Appendix A, Table 2-10). The following equations were used to compute the NPC of the options identified in Table 2-5:

- Installing and operating an RC

$$NPC_{RC} = K_{RC} + \sum_{t=0}^{n-1} \left[\frac{O_{RC}}{(1 + r)^t}\right] \text{ if } n \leq 7 \tag{1}$$

or

$$NPC_{RC} = K_{RC} + \sum_{t=0}^{n-1} \left[\frac{O_{RC}}{(1 + r)^t}\right] + \left[\frac{K_{RC}}{(1 + r)^7}\right] \text{ if } n > 7$$

- Accelerating the purchase of a new dry-to-dry machine with an RC

$$NPC_{DD} = K_{DD} + \sum_{t=0}^{14} \left[\frac{O_{RC}}{(1 + r)^t}\right] - \left\{ \left[\frac{K_{DD}}{(1 + r)^n}\right] + \sum_{t=n}^{14} \left[\frac{O_{RC}}{(1 + r)^t}\right] \right\} \tag{2}$$

- Performing the recordkeeping requirements

$$NPC_{RK} = K_{RK} + \sum_{t=0}^{14} \left[\frac{O_{RK}}{(1 + r)^t}\right] \tag{3}$$

- Building a room enclosure and installing a small CA

$$NPC_{RE/CA} = K_{RE} + K_{CA} \sum_{t=0}^{n-1} \left[\frac{O_{RE} + O_{CA}}{(1 + r)^t}\right] \qquad (4)$$

- Accelerating the purchase of a new dry-to-dry machine with an RC and an add-on small CA

$$NPC_{DD/CA} = K_{DD} + K_{CA} \sum_{t=0}^{14} \left[\frac{O_{RC} + O_{CA}}{(1 + r)^t}\right] -$$

$$\left\{ \left[\frac{K_{DD}}{(1 + r)^n}\right] + \sum_{t=n}^{14} \left[\frac{O_{RC}}{(1 + r)^t}\right] \right\} \qquad (5)$$

where

NPC_{RC}	=	the net present cost of an RC
K_{RC}	=	the capital cost of an RC
O_{RC}	=	the incremental operating cost of an RC net of solvent recovery savings
n	=	the remaining life of the existing machine (cannot exceed 15)
t	=	the year (1991 is year 0)
r	=	the WACC[1]
NPC_{DD}	=	the net present cost of accelerating the purchase of a new dry-to-dry machine with a built-in RC
K_{DD}	=	the installed capital cost of a new dry-to-dry machine with a built-in RC
NPC_{RK}	=	the net present cost of recordkeeping associated with either a CA or an RC
K_{RK}	=	the initial cost of recordkeeping associated with either a CA or an RC
O_{RK}	=	the annually recurring costs of recordkeeping associated with either a CA or an RC net of solvent recovery savings

[1]This cost of capital differs by firm financial status. The discount factor estimated for this assessment is 11 percent for firms in good financial condition, 12.5 percent for firms in average condition, and 15.4 percent for firms in poor condition. For a more complete discussion, see Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry (EPA, 1991) in Appendix A.

$NPC_{RE/CA}$ = the net present cost of building a room enclosure (RE) and installing a small CA

K_{RE} = the capital costs of a room enclosure

K_{CA} = the capital costs of a small CA

O_{RE} = the incremental operating costs of a room enclosure

O_{CA} = the incremental operating cost of a small CA including the solvent recovery savings

$NPC_{DD/CA}$ = the net present cost of accelerating the purchase of a new dry-to-dry machine with a built-in RC and installing an add-on CA

In computing these costs, several assumptions were made:

- The distribution of the remaining life of existing machines is rectangular. Dry-to-dry machines have a 15-year life; transfer machines have a 20-year life.
- Virtually no new transfer machines have been sold in the last 5 years. Therefore, one-fifteenth of the total population of machines retires each year.
- In the absence of regulation, all machines would have been replaced by new dry-to-dry machines. The current stock of machines would have been completely replaced by new machines within 15 years.
- Costs are computed for a 15-year period of analysis.[2]
- Plant owner(s) evaluate the cost of the control options using a real, after-tax WACC, which differs depending on their financial status. (See EPA, 1991 for a discussion of the method for computing the WACC.)
- The plant financial status, the WACC, and the share of facilities in each financial status are given below:

Status	WACC	Share of Facilities
below average	15.4%	25%
average	12.5%	50%
above average	11.0%	25%

[2] The mathematics of the cost formula require the notation of years 0-14, where year 0 is the first year.

- Operating costs are incurred at the beginning of each period. The costs of accelerating the purchase of a new dry-to-dry machine include the operating costs of an RC because most new dry-to-dry machines with vent controls use RC technology.

- RCs purchased for existing machines in the commercial and industrial sectors are used only for the remaining life of the existing machines or the remaining life of the control device, whichever is shorter. Because new machines for these sectors come equipped with built-in RCs, the add-on RC will not be transferred to the new machine.

- Machines with more than 7 years of remaining life must purchase an RC device in the first year and the eighth year. (These control devices have a 7-year life.) Facilities with 7 or fewer years of remaining life will purchase only one RC.

- The life of the room enclosure is equal to the remaining life of the transfer machine.

Even in the absence of the standard, it is projected that virtually all owner(s) of dry cleaning facilities would have purchased new dry-to-dry machines with built-in vent control devices when existing machines required replacement. Therefore, the cost of the accelerated purchase only includes costs associated with those years before the expiration of the current machinery. Those facilities with older existing equipment are more likely to choose the option to accelerate the purchase of a new dry-to-dry machine than are facilities with a longer remaining life. This selection occurs because the incremental cost of accelerating the purchase of a new dry cleaning machine is lower for facilities with older equipment.

2.3 ANNUALIZED CONTROL COSTS

Once the cost-minimizing decision is identified, based on the computations and assumptions outlined in Section 2.2, the annualized costs (AC) associated with each decision can be computed. The computations are relatively straightforward for facilities that purchase and invest in the required vent control device and/or room enclosure. Eq. (6) shows the method for computing these costs:

$$AC = \left[\frac{K}{\{1 - (1 + r)^{-n}\}/r}\right] + \left[\frac{K_{RK}}{\{1 - (1 + r)^{-15}\}/r}\right] + O + O_{RK} \quad (6)$$

where

- AC = the annualized compliance cost
- K = the installed capital costs of an RC and/or a room enclosure
- O = the annual operating costs of an RC and/or a room enclosure
- r = the weighted average cost of capital (described in the previous section)
- n = the remaining life of the existing machine (cannot exceed 15 years) or the remaining life of the control equipment, whichever is shorter
- K_{RK} = the initial costs of recordkeeping
- O_{RK} = the annually recurring costs of recordkeeping

In some instances it is less costly to accelerate the purchase of a dry-to-dry machine. Annualized costs associated with this option were computed by annualizing the NPC_{DD} or the $NPC_{DD/CA}$ computed in Eqs. (2) or (5) using the following equation:

$$AC = \left[\frac{NPV_{DD} \text{ or } NPV_{DD/CA}}{\{1 - (1 + r)^{-n}\}/r}\right] + \left[\frac{K_{RK}}{\{1 - (1 + r)^{-15}\}/r}\right] + O_{RK} \quad (7)$$

where NPC_{DD} and $NPC_{DD/CA}$ are as defined in Eqs. (2) or (5) and all other terms are as defined above.

Table 2-6 reports the annualized costs for facilities without baseline vent control devices. Tables 2-7 and 2-8 report the annualized costs for facilities with baseline RCs and CAs, respectively. The values reported in Tables 2-6 through 2-8 were used to compute the economic and financial impacts presented in Sections 3 and 4 of this report.

TABLE 2-6. ANNUALIZED COMPLIANCE COSTS PER FACILITY DUE TO THE FINAL STANDARDS: NO BASELINE VENT CONTROLS ($/facility/yr)

Industry Sector and Machine Capacity (kg/load)	Machine Technology	Annual Receipts Per Facility		
		$0 to $75K	$75 to $100K	Over $100K
Commercial				
6.8	Dry-to-Dry	345	4,874	7,765
8.2	Dry-to-Dry	345	4,897	5,835
11.3	Dry-to-Dry	345	2,442	5,648
13.6	Dry-to-Dry	345	2,429	3,792
15.9	Dry-to-Dry	345	2,445	3,813
15.9	Transfer	345	3,189	8,019
20.4	Dry-to-Dry	345	2,571	4,045
22.7	Dry-to-Dry	345	2,582	4,066
22.7	Transfer	345	3,253	8,454
27.2	Dry-to-Dry	345	2,603	2,063
45.4	Dry-to-Dry	345	3,520	2,971
45.4	Transfer	345	4,214	6,735
Industrial				
63.5	Dry-to-Dry	--	--	2,673
113.4	Dry-to-Dry	--	--	-3,003
113.4	Transfer	--	--	-8,544

Notes:

1. Annualized compliance costs are computed using the capital and operating costs presented in Tables 2-1 and 2-2 and the capital costs of a new dry-to-dry machine in Appendix A, Table 2-10.
2. Discount rates vary by firm financial status: 15.4 percent for firms in poor financial condition, 12.5 percent for firms in average financial condition, and 11 percent for firms in good financial condition.
3. RC and room enclosure capital costs are annualized over the remaining life of the dry cleaning machine or the life of the control equipment, whichever is shorter. Recordkeeping costs are annualized over 15 years.

TABLE 2-7. ANNUALIZED COMPLIANCE COSTS PER FACILITY DUE TO THE FINAL STANDARDS: RC BASELINE VENT CONTROLS ($/facility/yr)

Industry Sector and Machine Capacity (kg/load)	Machine Technology	Annual Receipts Per Facility		
		$0 to $75K	$75 to $100K	Over $100K
Commercial				
6.8	Dry-to-Dry	345	666	1,300
8.2	Dry-to-Dry	345	666	983
11.3	Dry-to-Dry	345	349	983
13.6	Dry-to-Dry	345	349	666
15.9	Dry-to-Dry	345	349	666
15.9	Transfer	345	349	666
20.4	Dry-to-Dry	345	349	666
22.7	Dry-to-Dry	345	349	666
22.7	Transfer	345	349	666
27.2	Dry-to-Dry	345	349	349
45.4	Dry-to-Dry	345	349	349
45.4	Transfer	345	349	349
Industrial				
63.5	Dry-to-Dry	--	--	358
113.4	Dry-to-Dry	--	--	358
113.4	Transfer	--	--	-5,785

Notes:

1. Annualized compliance costs in the commercial sector are computed using the capital and operating costs presented in Table 2-3. Costs for the industrial sector are computed using values reported in Tables 2-1 and 2-3.
2. Discount rates vary by firm financial status: 15.4 percent for firms in poor financial condition, 12.5 percent for firms in average financial condition, and 11 percent for firms in good financial condition.
3. Recordkeeping costs are annualized over 15 years. Room enclosure costs are annualized over the remaining life of the dry cleaning machine.

TABLE 2-8. ANNUALIZED COMPLIANCE COSTS PER FACILITY DUE TO THE FINAL STANDARDS: CA BASELINE VENT CONTROLS ($/facility/yr)

Industry Sector and Machine Capacity (kg/load)	Machine Technology	Annual Receipts Per Facility		
		$0 to $75K	$75 to $100K	Over $100K
Commercial				
6.8	Dry-to-Dry	345	824	1,628
8.2	Dry-to-Dry	345	824	1,226
11.3	Dry-to-Dry	345	428	1,243
13.6	Dry-to-Dry	345	428	836
15.9	Dry-to-Dry	345	428	836
15.9	Transfer	345	428	836
20.4	Dry-to-Dry	345	428	836
22.7	Dry-to-Dry	345	428	836
22.7	Transfer	345	428	836
27.2	Dry-to-Dry	345	428	428
45.4	Dry-to-Dry	345	428	428
45.4	Transfer	345	428	428
Industrial				
63.5	Dry-to-Dry	--	--	437
113.4	Dry-to-Dry	--	--	437
113.4	Transfer	--	--	-5,706

Notes:

1. Annualized compliance costs in the commercial sector are computed using the capital and operating costs presented in Table 2-3. Costs for the industrial sector are computed using values reported in Tables 2-1 and 2-3.
2. Discount rates vary by firm financial status: 15.4 percent for firms in poor financial condition, 12.5 percent for firms in average financial condition, and 11 percent for firms in good financial condition.
3. Recordkeeping costs are annualized over 15 years. Room enclosure costs are annualized over the remaining life of the dry cleaning machine.

SECTION 3
ECONOMIC IMPACTS

Economic theory provides a framework for analyzing the links between the demand and supply conditions an industry faces, the industry's market structure, and the typical behavior of firms in that industry. This section examines market structure in the dry cleaning industry and develops an approach for estimating the impacts of an increase in the cost of supplying dry cleaning services. A neoclassical supply/demand analysis was used to project market impacts due to the standards. Price and quantity adjustments were computed using a model market approach that considers market structure in the commercial and industrial sectors of the dry cleaning industry. These adjustments were used to project consumer and producer welfare effects, plant closures, and employment effects.

3.1 MARKET STRUCTURE

Within each sector of the dry cleaning industry, many localized geographical markets exist where only neighboring firms compete directly. Although submarkets are only loosely tied to a national market, economic decisions by individual firms are related to national trends. The existing market structure reflects fundamental market forces that are likely to be an enduring feature of the dry cleaning industry. The economic impact analysis uses the differences in market structure and pricing practices of dry cleaning facilities to predict the market adjustments in response to the standards.

3.1.1 Market Structure in the Commercial Sector

Two basic market structures are prevalent in the commercial sector. The first is a competitive structure, which is found predominantly in urban and suburban areas and characterized by the existence of many dry cleaning facilities in each market area and no barriers to entry. Approximately 90 percent of the commercial facilities are in urban/suburban market areas. The second type of market structure is characterized by a single plant in a rural market area (see Appendix A for a discussion of market structure). Because consumers are unwilling to drive long distances to purchase dry cleaning services, the owner of a single plant in a remote area does not behave as if in a perfectly competitive market.

Urban/Suburban Markets. For this analysis, it was assumed that a competitive market structure exists for commercial dry cleaning facilities located in urban and suburban areas. The competitive model is based on the hypothesis that no plant individually can influence market equilibrium, but the behavior of all producers taken together determines the position of the market supply curve. In addition, the cost of producing the last unit of output, the marginal cost, along with market demand determines equilibrium price and output. Furthermore, at a stable equilibrium price, each individual plant can sell any level of output desired, with no perceptible effect on equilibrium values. As a result, each plant faces an implicit demand curve that is perfectly elastic (horizontal) at the current market equilibrium price.

Initially, imposing controls on a plant will alter the costs of producing the same level of output as before the controls. This production cost change will induce a shift of that plant's supply curve. Because the supply curve for a well-defined market is the horizontal summation of individual plant supply curves for all facilities participating in that market, the shift in the market supply curve can be determined from knowledge of plant-specific shifts.

The position of the market demand curve is critical to determining the change in equilibrium price and output resulting from a shift in the market supply curve. The slope of the demand curve measures the responsiveness of quantity demanded to a change in the price of the service. The elasticity of demand is a relative measure of demand responsiveness and is measured as the percentage change in quantity demanded of a good or service resulting from a one-percent change in its price.

Price and output adjustments and the resulting welfare changes can be calculated if the baseline price and output values, the relative shift of the market supply curve, and estimates of demand and supply elasticities are available. Three of these components--the baseline price and output values, demand elasticity, and supply elasticity--are estimated in the Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry (EPA, 1991) contained in Appendix A. Estimated baseline price is $6.34 per kg in the commercial sector and $2.00 per kg in the industrial sector. Baseline output levels vary with each sector and model market. Demand and supply elasticity estimates are -1.086 and 1.558, respectively. The final component, the relative shift of the market supply curve, is based on the annualized costs of the standards computed in Section 2.

Rural Markets. The outstanding characteristic of the structure of the dry cleaning industry in rural communities is the prevalence of markets that are served by a single plant. Another salient characteristic of rural dry cleaning facilities is that annual revenues are typically below $25,000. The small scale of the market in rural communities requires the operation of a minimally sized plant. The only option available to a new entrant, therefore, is to double (at the minimum) capacity in the market.

Although these single-plant markets are not perfectly competitive, the ease of entry into the dry cleaning industry implies that the threat to long-run profits from new entrants is keen and persistent. The optimal pricing strategy is to set a profit-maximizing price that is low enough to deter entry. Therefore, to model the economic impact of the proposed regulations, it was assumed that the owners of firms in single-plant rural markets follow a limit-pricing strategy. The assumptions of potential large-scale entry and output maintenance allow application of the theory of limit-pricing developed by Bain, Sylos-Labini, and Modigliani (Sherer, 1980).

Any price above the average total cost of a new plant would encourage new entry into the market. The existence of a second plant in the market would decrease the market share and the total revenue of the initial supplier. Assuming that the productivity of dry cleaning equipment has been increasing over time, owners of new equipment would tend to have lower marginal costs than owners of older equipment. Therefore, the market price would probably decline with the entrance of a second plant, further decreasing the total revenue of the existing supplier.

Furthermore, if the assumption of increased productivity is correct, owners of new facilities may be able to set prices at a level where initial suppliers would not be able to cover their costs of production. If the price set by the new supplier fell below the variable costs of production for the initial supplier, then the initial supplier would cease operations. If the initial supplier could cover variable costs but not all the fixed costs of production, then the plant would continue to operate in the short run but would face potential financial failure. Facing this potential erosion in profits and/or financial failure, the owner of an existing plant is most likely to adopt the pricing strategy that presents the strongest deterrent to a potential entrant to ensure that his market share is not eroded.

Because both new and existing facilities with less than $25,000 in annual receipts are subject to recordkeeping requirements under the final standards, the new entrant's long-run average cost curve is affected. Therefore, the limit price set by an existing plant would potentially change in response to the standards.

To compute the price and output adjustments and the resulting welfare changes for these rural (single facility) markets, the baseline price and output values, the relative shift of the marginal cost curve, and estimates of demand elasticity are required. As noted above, the baseline price and output values and demand elasticity are estimated in the Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry (EPA, 1991) contained in Appendix A. The relative shift of the marginal cost curve is based on the annualized costs of the standards computed in Section 2.

Model Market Approach. To facilitate computing impacts of the standards, actual dry cleaning facilities were allocated among model markets. Six model markets represent the commercial sector and are differentiated by

- rural and urban areas,
- the proportion of facilities with baseline vent controls,
- the income distribution of facilities represented, and
- the behavioral response to a cost increase.

Table 3-1 characterizes the model markets by share of facilities with baseline vent controls (due to state regulation) and the total number of facilities allocated to each market (EPA, 1991).

Rural markets are represented by Model Markets A and B. It was assumed that all facilities in these model markets are small establishments that receive $25,000 or less in annual revenue. In addition, it was assumed that these small rural areas have only one plant providing commercial dry cleaning services for the entire market area. Market A represents areas that have a single plant with a vent control in place in the baseline. Market B represents those areas with a single plant that does not have a baseline vent control. These facilities are only subject to recordkeeping requirements under the final standards because of a size cutoff for vent control and room enclosure requirements.

TABLE 3-1. PROFILE OF MODEL MARKETS IN THE COMMERCIAL SECTOR

Market Model	Market Description[a]	Share of Facilities with Baseline Vent Controls	Total Number Facilities
A	Rural	All facilities controlled	1,543
B	Rural	No facilities controlled	1,606
C	Urban/suburban	All facilities controlled	1,157
D	Urban/suburban	Controlled facilities dominate	10,432
E	Urban/suburban	Controlled and uncontrolled facilities evenly distributed	8,073
F	Urban/suburban	Uncontrolled facilities dominate	7,683
Total			30,494

Source: U.S. Environmental Protection Agency. 1991. Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry. Final report prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA 450/3-91-021.

[a]Rural markets are defined as locales with population of 2,500 or less that are not part of a metropolitan statistical area. For this assessment, rural markets have only one plant per market area.

Urban/suburban commercial markets are represented by Model Markets C through F. These model markets are characterized as having more than one plant in each market area. Facilities of every income level operate in market areas represented by these urban/suburban model markets. Market C represents those urban/suburban markets where all facilities have baseline vent control devices as a result of stringent State regulation. Similarly, Market D describes those areas where most of the facilities have baseline vent controls as a result of State regulation that mandates vent controls for most facilities. All of the impacts in Market C and most of the impacts in D are due to recordkeeping requirements. Markets E and F contain a mixture of facilities with and without baseline vent controls. Impacts in Markets E and F are the result of recordkeeping, vent control, and room enclosure requirements.

3.1.2 Market Structure in the Industrial Sector

Like commercial facilities located in urban/suburban areas, industrial facilities operate in perfectly competitive markets. However, no price and output adjustments due to the standards are likely to occur in this sector for two reasons. First, water and detergent are near-perfect substitutes for PCE because virtually all of the garments dry cleaned by industrial facilities are water-washable. Because consumers do not dictate the cleaning method used, facilities facing a control cost with continued PCE use would likely substitute water washing for dry cleaning assuming sufficient capacity is available.

Second, industrial cleaners typically do not charge different prices for garments cleaned in water and detergent and garments cleaned in PCE; also, over 92 percent of the output from industrial facilities is from regular laundry operations. This second factor is evidence that the cost of producing the marginal unit of output in the market area is not likely to increase because of the standards. For these reasons, producers would not be able to pass along any of the control costs in the form of a price increase.

3.2 AFFECTED POPULATION

The affected population includes facilities affected by recordkeeping requirements only and facilities affected by some combination of recordkeeping, vent control, and room enclosure requirements. The number of affected facilities varies depending on the model market analyzed. Table 3-2 shows the number of affected facilities in each model market under each type of requirement.

Table 3-3 shows the share of the total facilities in each model market potentially affected by the type of control requirement. Only 11 percent of the facilities in the commercial sector are projected to incur costs beyond recordkeeping costs. Approximately 82 percent of commercial facilities use PCE in the

TABLE 3-2. NUMBER OF FACILITIES AFFECTED BY THE STANDARDS

Industry Sector and Model Market	Type of Requirement		
	Vent Control	Room Enclosure	Recordkeeping
Commercial			
A	0	0	1,071
B	0	0	1,606
C	0	0	843
D	115	29	7,682
E	1,621	409	6,979
F	1,725	436	6,766
Total Commercial	3,461	874	24,947
Industrial	65	84	130

TABLE 3-3. SHARE OF FACILITIES AFFECTED BY THE REQUIREMENTS OF THE STANDARDS

Industry Sector and Model Market	Total Number of Facilities	Type of Requirement		
		Vent Control (%)	Room Enclosure (%)	Record-keeping (%)
Commercial				
A	1,543	0	0	69
B	1,606	0	0	100
C	1,157	0	0	73
D	10,432	1	0	74
E	8,073	20	5	86
F	7,683	22	6	88
Total Commercial	30,494	11	3	82
Industrial	395	16	21	33

Notes:

1. The total number of facilities includes PCE facilities as well as those that do not use PCE in the dry cleaning process (see Appendix A).
2. The share affected is computed based on the estimated number of affected facilities reported in Table 3-2.

dry cleaning process and all of these PCE facilities are affected by the recordkeeping requirements. In the industrial sector, approximately 16 percent of facilities are affected by the vent control requirements, 21 percent are affected by the room enclosure requirements, and 33 percent are affected by the recordkeeping requirements.

Model Markets A through C were not projected to incur impacts under the proposed standards because facilities in these markets are either below the cutoff for vent control devices (Markets A and B) or have baseline vent controls (Markets B and C), and because recordkeeping costs were not included when calculating impacts for the proposed standards. However, recordkeeping costs were included in this analysis. Consequently, impacts were computed for facilities in all markets including Markets A through C. A higher proportion of the facilities in each of the urban/suburban model markets will potentially incur impacts under the final standards.

3.3 MARKET ADJUSTMENTS

The final standards are likely to disturb the current equilibrium in the dry cleaning industry, resulting in price and output changes and corresponding welfare impacts, plant closures, and employment effects. All commercial markets are projected to incur price and output adjustments and consumer and producer welfare impacts. However, the industrial sector is projected to incur producer welfare impacts only.

3.3.1 Price and Output Adjustments

Incremental impacts of the requirements were quantified through estimated market adjustments in price and output for both urban/suburban and rural markets in the commercial sector. Figure 3-1 depicts the supply/demand relationship for a competitive urban/suburban market area. Equilibrium prior to the standards occurs at an output level of Q_1 and a price of P_1 per unit

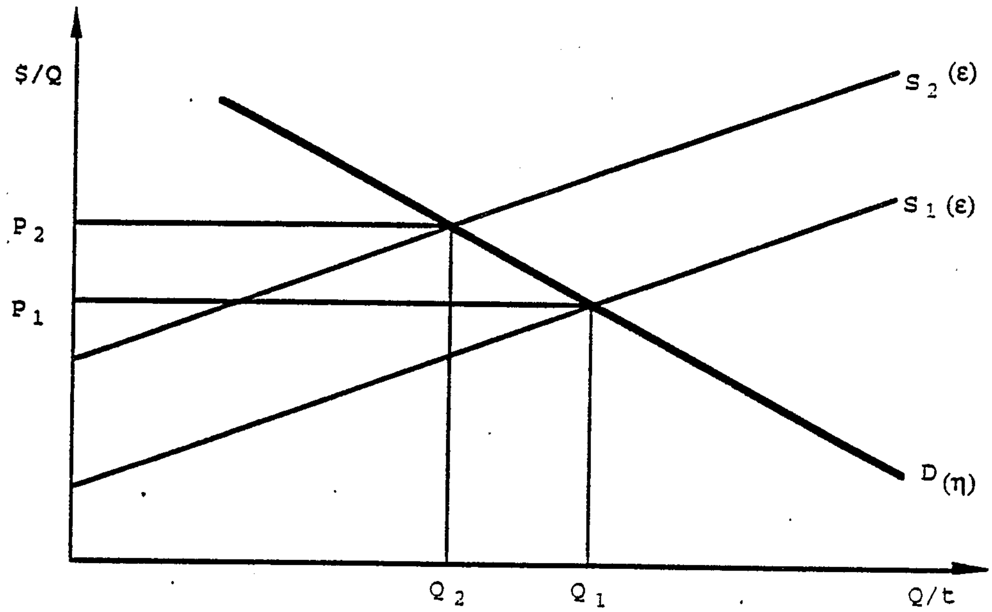

Figure 3-1. Price and Output Adjustments Due to Increased Costs of Production: Urban/Suburban Markets

(kilogram) of output. The supply curve (S_1) is upward sloping with an elasticity of "ε" and the demand curve (D) is downward sloping with an elasticity of "η."

Assuming that the standards result in a net cost increase for facilities in the representative urban/suburban market, the market supply curve will shift up from a position such as S_1 to S_2 in Figure 3-1. The vertical shift distance is equal to the average compliance cost per unit of output due to the standards.

Assuming that the market demand curve remains stationary in response to technological controls is plausible because these controls normally affect only supply-side variables such as production costs. In addition, the candidate control devices will not lessen the quality of the product, further justifying a stationary demand curve. If the new supply curve (S_2) now intersects the downward sloping demand curve at a higher point than the baseline supply curve (S_1), price increases and quantity decreases result.

As noted above, the magnitude of the new equilibrium price/output combination (P_2, Q_2) can be computed if baseline price and output values, the demand elasticity, the supply elasticity, and the supply shift parameters are known. Assuming that no correlation exists between production costs and control costs, the shift in the supply function of the marginal plant may correspond to the lowest control cost (zero in markets with unaffected facilities) or highest control cost per kilogram of output estimated. For this analysis, the supply shift was based on the expected value of the percentage change in marginal costs for the given market area. Measured along the price axis, the expected percentage shift of the supply function is equal to the average compliance cost per unit of output divided by the baseline price.

Figure 3-2 depicts the demand and supply conditions facing a single supplier in a rural market area. The position of the marginal cost curve is difficult to estimate without using detailed data on input prices at different output levels. However, such data are not available. For analytical convenience, the marginal cost curve (MC_1) is assumed to be horizontal over the relevant range. The demand curve (D) is downward sloping with an elasticity of "η." As in the urban/suburban market, equilibrium prior to the standards occurs at an output level of Q_1 and a price of P_1 per unit (kilogram) of output.

An upward shift in the (horizontal) marginal cost curve (from M_1 to MC_2) of a monopoly supplier in rural market results in price increases and quantity decreases. As noted previously, suppliers in these rural markets probably practice limit pricing to deter new entry. However, the standards result in higher long-run average costs for new entrants and a correspondingly higher limit price for current suppliers. Consequently, price and output adjustments are projected for Markets A and B.

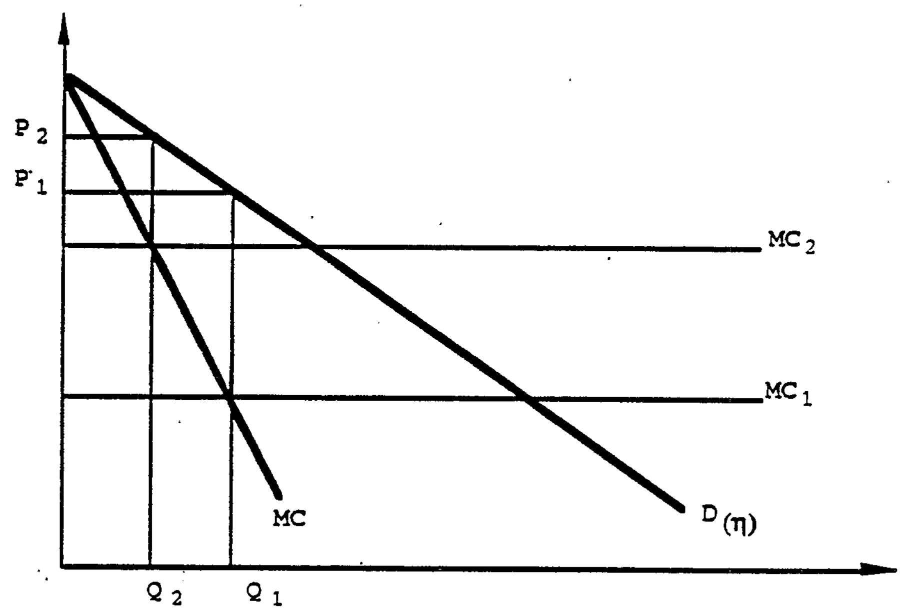

Figure 3-2. Price and Output Adjustments Due to Increased Costs of Production: Rural Markets

Projected price and output adjustments due to the standards are reported in Table 3-4. Average price impacts for the entire commercial sector are not reported in this table because the average impact underestimates price adjustments for markets where affected facilities dominate and overestimates adjustments with no affected or very few affected facilities. Therefore, price impacts in the commercial sector are only presented by model market.

Estimated price and output adjustments due to the standards are less than 2.5 percent (in absolute value) for all markets in the commercial sector. As noted above, no price and output adjustments are projected for the industrial sector.

TABLE 3-4. PROJECTED PRICE AND OUTPUT ADJUSTMENTS DUE TO THE STANDARDS

Industry Sector and Model Market	Baseline Price ($/kg)	Price Adjustment (%)	Baseline Output (Mg/yr)	Output Adjustment (%)
Commercial Markets				
A	6.34	2.29	3,669	-2.11
B	6.34	2.29	3,819	-2.11
C	6.34	0.15	25,477	-0.16
D	6.34	0.17	227,709	-0.18
E	6.34	0.57	155,823	-0.62
F	6.34	0.63	145,898	-0.69
Total Commercial	6.34	--	562,396	-0.46
Industrial	2.00	0.00	170,902	0.00

3.3.2 Welfare Impacts

The costs of a regulatory policy are measured by the change in social welfare that it generates. The sum of the producer and consumer surplus losses is an estimate of the loss in social welfare due to the standards. The estimates do not include the welfare impacts associated with potential changes in environmental quality. Note that these estimates of welfare impacts are for the costs of controlling emissions only. Benefits resulting from changes in environmental quality are not reflected in the estimated welfare impacts.

Producer welfare impacts result from increased costs of production that are fully or partially absorbed by the plant. Facilities that are unable to pass along any price increase must absorb the total increase in costs. Producer welfare impacts in these markets are equivalent to the costs of control. Facilities that operate in markets where a price increase is likely are able to pass along a portion of the increased costs of production. The producer welfare impact in these markets is equivalent to some portion of the compliance costs depending on the relative elasticity of supply and demand.

Consumers of dry cleaning services experience welfare impacts in markets where price and output adjustments occur. Consumer welfare impacts in the industrial sector are zero because price and output is not affected. Both sectors incur producer welfare impacts.

Estimates of the surplus changes for consumers and producers and the resulting change in social welfare are presented in Table 3-5. In the commercial sector, estimated consumer welfare impacts are -$17.8 million. Producer welfare impacts total approximately -$11.8 million. In the industrial sector, estimated consumer welfare impacts are zero (because price and quantity adjustments are zero), and producer welfare impacts are a positive $607,000 because of a projected net savings due to the standards.

TABLE 3-5. PROJECTED WELFARE IMPACTS DUE TO THE STANDARDS

Industry Sector and Model Market	Consumer Welfare Impacts ($1,000)	Producer Welfare Impacts ($1,000)	Net Welfare Impacts ($1,000)
Commercial Markets			
A	-526	-11	-538
B	-548	-12	-560
C	-239	-167	-406
D	-2,437	-1,703	-4,141
E	-5,643	-3,969	-9,612
F	-5,819	-4,096	-9,915
Total Commercial	-15,212	-9,958	-25,170
Industrial	0	607	607

These welfare impacts are projected for the first year after the regulation is in effect. Fewer losses will be incurred in 14 subsequent years because existing uncontrolled transfer and dry-to-dry machines are being replaced with dry-to-dry machines with built-in vent controls upon retirement even at baseline.

Adding the producer and consumer welfare effects leads to an estimate of the total control cost for each sector. In the commercial sector net welfare impacts due to the standards are estimated to total--$25 million. Net welfare impacts in the industrial sector represent a gain of $607,000.

3.3.3 Plant Closures

To comply with a regulatory standard, facilities will normally incur control costs and may have to reduce production levels, modify production processes, or--as a last resort--shut down. In the short run, the decision to shut down depends on the relationship between the price of the service and the average variable cost of production. The position of the average variable cost curve is difficult to estimate without using detailed financial data including input prices. As a result, this section offers qualitative impacts based on output adjustments for each sector. Specifically, it is assumed that the entire output adjustment is a result of plant closures.

It should be noted that the estimates of plant closures presented in this analysis are based on assumptions that potentially underestimate the <u>gross</u> or total number of plant closures while potentially overestimating the <u>net</u> plant closures. Because the number of plant closures are presented as net of new plants entering the market, the estimated number of plant closures do not reflect <u>gross</u> plant closures[1]. However, two assumptions have the effect of making the estimates worst-case in terms of <u>net</u> closures. First, it was assumed that facilities do not reduce

[1]The estimates of potential changes in ownership presented in Section 4 reflect gross plant closures as well as other changes in ownership such as (voluntarily or involuntarily) selling the plant to an owner in better financial condition. Consequently, the potential changes in ownership reported in Section 4 exceed the estimates of plant closure presented in this section.

capacity utilization, but rather the entire output reduction was accounted for by facilities shutting down. In addition, it was assumed that the smallest plants projected to incur costs beyond recordkeeping costs account for all the plant closures in Markets C through F. In Markets A and B, plants do not incur any impacts beyond recordkeeping costs. Consequently, the smallest plants ($0 to $25,000 in annual receipts) account for all of the plant closures in Markets A and B because only the smallest plants are represented in these markets.

Under these worst-case assumptions, an estimated 259 net plants are projected to close in the commercial sector as a result of the standards. No plant closures are projected for the industrial sector in view of the cost savings expected for this sector.

Considering the size of the estimated output reduction, commercial plants will probably adjust production levels without actually closing their facilities. Evidence from Census data indicates that facilities do respond to changes in the quantity demanded by increasing or reducing output per plant. Census data indicate that commercial facilities with payroll were operating at higher output levels on average in 1987 than in 1982. Using data on average annual receipts, the number of plants, the base price, and the share of receipts from dry cleaning activities, the average plant dry cleaned 24,489 kilograms of clothing in 1982 and 28,335 kilograms in 1987. One industry spokesman indicated that these changes do not reflect a trend toward larger dry cleaning plants; rather, plants are operating at a higher capacity utilization (Fisher, 1990).

3.3.4 Employment Effects

The standards may cause short-run price impacts in the sectors of the dry cleaning industry examined in this assessment. If the short-run effect of a regulatory control is to increase the equilibrium price of dry cleaning services, then the short-run market-clearing output of services will be lower than the baseline output. If the market-clearing output declines, the demand for labor services by operators of dry cleaning facilities may also decline. Indeed, the reduction of labor demand may be approximately proportional to the reduction in demand for dry cleaning services. Current employees in dry cleaning facilities may incur a welfare loss in the form of reduced pay or lost jobs.

Facilities in the industrial sector are projected to realize a cost savings due to the solvent recovery savings associated with the standards. Consequently, the anticipated output impacts on industrial launderers are likely to be zero, so employment effects in this sector are not considered further.

However, in the commercial sector, two employment effects of the standards are considered: employee displacements and employee displacement costs. Displacements are job terminations that result from cut-backs at operating facilities and/or plant closures. Displacement costs are welfare losses incurred by those displaced workers. These employment impacts are short-run effects. The primary effects of the standards are short-run effects because it is projected that virtually all dry cleaning machines are being replaced at baseline by controlled, dry-to-dry machines.

Because closures may occur and output reductions among operating facilities can themselves result in worker displacements, this analysis assumed that short-run employment impacts of standards are proportional to projected output effects. An estimated 176,336 workers were on payroll at commercial dry cleaning plants in 1991 (EPA, 1991). Estimated worker displacements computed as described above total 813.

Displaced workers suffer welfare losses through several mechanisms (see Hamermesh, 1989; Maxwell, 1989; Blinder, 1988; Flaim, 1984; and Gordon, 1978):

- foregone wages and benefits during job search;

- out-of-pocket search costs,
- diminished wages and/or job satisfaction at new jobs, and
- psychological costs.

Displacement risk--like risk of injury, risk of death, or otherwise unpleasant working conditions--is a negative job attribute for which workers receive compensation in competitive labor markets (Abowd and Ashenfelter, 1981). Abowd and Ashenfelter (1981) found that the labor market compensates anticipated layoffs and unemployment by 2 to 6 percent higher wages per year. Topel (1984) used a hedonic wage function to estimate that an anticipated one-point increase in the probability of unemployment (e.g., from 6 per 100 workers to 7 per 100 workers) requires a 2.5 percent increase in wages to compensate workers.

Anderson and Chandran (1987) developed and demonstrated a methodology to compute a willingness-to-pay based estimate of worker displacement using Topel's estimated compensating wage differential. Their method is analogous to that used by economists to estimate the implicit value of a life using labor market data (see Moore and Viscusi, 1990). The hedonic displacement cost estimate conceptually approximates the one-time willingness to pay to avoid an involuntary unemployment episode. Theoretically, it includes <u>all</u> worker-borne costs <u>net</u> of any off-setting pecuniary or nonpecuniary "benefits" of unemployment (e.g., unemployment compensation, leisure time enjoyment). The hedonic displacement cost estimate is a net present valuation.

Average annual (1991) earnings in the (payroll commercial) dry cleaning industry are $11,504 (U.S. Department of Labor, 1991). Using Topel's compensating differential estimate and the Anderson-Chandran methodology, this analysis projects that dry cleaning workers would demand an annual compensating differential of $288 ($11,504 *0.025) to accept a one-point increase in the probability of displacement. It was assumed that they would be willing to pay an equivalent amount to avoid such an increase in the probability of displacement. Therefore, the implied statistical cost of an involuntary layoff is $28,800 ($288/0.01). The estimated worker displacement costs were computed by multiplying the estimated number of workers displaced by the estimated cost of an involuntary layoff. Worker displacement costs computed in this way total $23.4 million.

SECTION 4
FINANCIAL IMPACTS

The final standards will potentially affect business entities that own dry cleaning facilities (see Appendix A for a financial profile of potentially affected firms in the commercial sector). In the financial analysis, distinguishing between the terms "firm" (or "company") and "establishment" (or "facility") is important. The Census of Service Industries defines a firm as a "business organization or entity consisting of one domestic establishment or more under common ownership or control." An establishment, in turn, is defined as a "single physical location at which business is conducted." In Section 2, economic impacts are evaluated using model <u>facility</u> data. The focus of this section, however, is on potentially affected <u>firms</u>.

Firms in the industrial sector are projected to incur a cost savings due to the standards. Consequently, financial impacts were computed for firms in the commercial sector only. This analysis assumes that the owner(s) of an affected firm will pursue a course of action that maximizes the value of the firm, subject to uncertainties about actual costs of compliance and the behavior of other firms. The owners' response options include

- closing the plant,
- bringing the plant into compliance with the regulation, and
- selling the plant.

If the expected post-compliance value of an affected plant is negative (or simply lower than the "scrap value" of the plant), the owner of the plant will likely close it. If the expected post-compliance value is positive and greater than the scrap value, the owner will <u>either</u> bring it into compliance <u>or</u> sell it to another firm that will do so.

Whether the firm keeps or sells the plant depends on the financial condition of the firm. If the firm has and/or can borrow sufficient funds to make a plant compliant, it keeps the plant. If instead the firm has inadequate funds and debt capacity, it sells or closes the plant. This section addresses these potential changes in ownership.

4.1 FINANCIAL CHARACTERISTICS

Firm financial impacts were computed for firms in three conditions of firm financial health: below average, average, and above average. This analysis assumed that firms in below-average financial condition cannot borrow money. These firms either have sufficient cash and purchase the control equipment, or they have insufficient funds and sell the plant to another firm.

Firms in average or above-average financial condition were assumed to borrow the required funds, though possibly some of them will use internal funds instead of, or in conjunction with, borrowing. It was assumed that 7-year bank notes at 11 percent (nominal) interest are available to above-average firms and that similar notes at 11.5 percent interest are available to average firms (see Appendix A for a discussion of the cost of borrowing for firms in different financial conditions). Firms in average and above-average financial condition can borrow funds and thus don't have to use cash to purchase control equipment. Their recurring annual expenses, however, include interest and principal payments on 7-year notes in addition to annual operating costs. Firms in below-average financial condition have large cash requirements because they cannot borrow money, but they have only operating costs as recurring annual expenses.

4.1.1 Distribution of Potentially Affected Firms

Estimating the number of firms affected is necessary to estimate the financial impacts of the standards. As explained in Section 1, not all dry cleaners would be affected by the standards because plants that use solvents other than PCE will be unaffected by the requirements. Furthermore, the level of impacts incurred by a firm may vary depending on whether facilities owned by the firm are required to install vent controls, build room enclosures, or simply perform recordkeeping requirements. In this section, we focus on firms that own facilities projected to incur costs beyond the recordkeeping costs for two reasons. First, recordkeeping costs do not include a large initial investment requiring the use of external funds or significant cash reserves. Consequently, no capital availability impacts would result from these costs. Second, profitability impacts from recordkeeping costs are potentially significant only for the smallest firms in poor financial condition. However, most of the firms in this size category operate in markets (Markets A and B) where producers will be able to pass all of these costs on to consumers. Consequently, no profitability impacts due to recordkeeping costs are expected. In the balance of this section, therefore, affected firms include those that own facilities required to invest in vent controls or room enclosures in addition to their recordkeeping costs.

Affected firms and affected plants are one-and-the-same for single-plant firms (i.e., single-plant firms without an affected plant are themselves unaffected as business entities). In the case of multi-plant firms, the number of affected firms is harder to estimate. A six-plant firm, for example, might have six affected plants, six unaffected plants, or any combination of both. In this assessment, it was assumed that all of the plants owned by a single firm are either affected or unaffected and that all plants owned by a single firm are affected equivalently. In addition, it was assumed that the proportion of affected <u>firms</u> is identical to the proportion of affected <u>plants</u> for all firm sizes. The estimated total number of affected firms is probably not too sensitive to these assumptions because only 478 of 27,332 firms (1.75 percent) have more than two plants (see Appendix A).

An estimated 3,336 firms own facilities projected to incur costs beyond recordkeeping costs under the final standards. These affected firms include 660 businesses with $75,000 to $100,000 in annual receipts and 2,676 firms with more than $100,000 in annual receipts. Under Financial Scenario I, which assumes a <u>positive</u>

relationship between size and baseline financial condition, no firms above $50,000 in annual receipts are classified as below average in financial condition (see Appendix A for a discussion of the financial scenarios used in this analysis). Consequently, under Financial Scenario I, all of the affected firms are in average or above-average financial condition. (A size cutoff exempts facilities below $75,000 in annual receipts from vent control and room enclosure requirements.)

Under Financial Scenario II, we assumed that <u>no</u> relationship exists between firm size and financial condition. Under this financial scenario, 50 percent of all firms, regardless of size, are allotted to the "average financial condition" grouping, and 25 percent of all firms to each of the "below-average" and "above-average" financial condition groupings. Under Financial Scenario II, 834 firms are in below-average financial condition (3,336 * 25%), 1,668 firms are in average financial condition (3,336 * 50%), and 834 firms are in above-average financial condition (3,336 * 25%).

4.1.2 Baseline Financial Ratios

Financial ratios are commonly used to measure a firm's financial viability. Financial ratios computed for this analysis include four fundamental types:

- liquidity ratios
- activity ratios
- leverage ratios
- profitability ratios

Baseline financial ratios were computed for potentially affected dry cleaning firms using data from Duns Analytical Services (1990) for three categories of financial health (see Appendix A, p. 5-17). The changes that are made to the baseline financial statements in response to the requirements of the standards result in adjusted financial ratios for firms. These adjusted ratios are reported in the following subsection.

4.2 OWNERSHIP ADJUSTMENTS

The firm financial impacts of the regulatory alternatives are assessed by

- computing with-regulation *pro forma* income statements and balance sheets of firms of different sizes and financial conditions,
- computing the implied with-regulation financial ratios of these firms, and
- comparing baseline and with-regulation statements and ratios to discern clearly adverse financial impacts.

Table 4-1 shows the with-regulation financial statements of potentially affected firms in below-average, average, and above-average financial condition.

The following adjustments were made to project the with-regulation financial statements of firms in below-average financial condition. In the annual income statement, other expenses and taxes increase by the amount of the annually recurring compliance costs, and net profits fall by the same amount. In the balance sheet, cash declines by the price of the control equipment and fixed assets rise by the same amount. These firms simply "trade" cash for control devices in an accounting sense, so total assets and total liabilities remain unchanged.

The following adjustments were made to project the with-regulation financial statements of firms in average and above-average financial condition. In the annual income statement, other expenses and taxes increase by the amount of the recurring compliance costs and the annual note payments, and net profits fall by the same amount. In the balance sheet, cash is unaffected because these firms borrow money for purchasing control equipment. Fixed and total assets increase by the value (price) of the control equipment. On the liabilities side of the balance sheet,

TABLE 4-1. WITH-REGULATION FINANCIAL STATEMENTS BY BASELINE FINANCIAL CONDITION

	Below Average		Average		Above Average	
	$75 to $100K	Over $100K	$75 to $100K	Over $100K	$75 to $100K	Over $100K
Income Statement						
sales	93,829	367,510	93,829	367,510	93,829	367,510
cost of goods	43,848	171,746	41,191	161,337	38,533	150,928
gross profit	49,981	195,764	52,638	206,173	55,296	216,582
other expenses and taxes	49,529	192,627	48,138	185,448	45,141	173,735
net profit	452	3,138	4,500	20,725	10,155	42,847
Balance Sheet						
cash	-5,667	-14,167	8,191	32,083	7,295	28,574
accounts receivable	6,478	25,373	3,439	13,471	1,414	5,538
cash plus accounts receivable	811	11,206	11,630	45,554	8,709	34,112
other current assets	4,887	19,140	5,069	19,853	3,981	15,594
total current assets	5,698	30,346	16,699	65,407	12,691	49,706
fixed assets	48,055	180,193	24,214	86,811	19,775	69,426
other noncurrent assets	11,928	46,718	11,676	45,732	12,399	48,566
total assets	65,680	257,257	52,589	197,950	44,865	167,698

(continued)

TABLE 4-1. WITH-REGULATION FINANCIAL STATEMENTS BY BASELINE FINANCIAL CONDITION (CONTINUED)

	Below Average		Average		Above Average	
	$75 to $100K	Over $100K	$75 to $100K	Over $100K	$75 to $100K	Over $100K
Balance Sheet (continued)						
accounts payable	3,518	13,779	2,082	8,154	537	2,105
loans payable	306	1,198	181	709	47	183
notes payable	4,206	16,474	4,070	14,212	2,199	6,908
other current liabilities	8,259	32,349	4,888	19,144	1,262	4,942
total current liabilities	16,289	63,800	11,221	42,218	4,045	14,138
noncurrent liabilities	23,119	90,554	17,728	62,217	9,725	30,883
total liabilities	39,408	154,354	28,949	104,435	13,770	45,021
net worth	26,272	102,903	23,640	93,515	31,095	122,677
capital	49,392	193,457	41,368	155,732	40,820	153,560
total liabilities and net worth	65,680	257,257	52,589	197,950	44,865	167,698

Note:

With-regulation financial statements are projected based on financial statements of typical dry cleaning firms reported in Duns Analytical Services (1990) and costs presented in Section 2.

total liabilities and net worth have to increase by the same amount. Both current and noncurrent liabilities increase. Notes payable (this year) increase by the amount of the annual principal payment. Noncurrent liabilities (which include bank notes) increase by the loan amount (control equipment price) less the amount of principal payable this year (which is part of the increase in notes payable).

4.2.1 Ratio Analysis

Table 4-2 reports the with-regulation financial ratios of affected firms of different sizes and financial types derived from the financial statements presented in Table 4-1. The impacts of the regulation on firms in below-average and average financial condition are most apparent, but impacts even on above-average firms may be substantial. The debt ratios of average and above-average firms increase very substantially because they borrow funds to purchase control equipment. The debt ratio of below-average firms is unaffected because they must rely on cash rather than borrowed funds to purchase equipment, but liquidity impacts are substantial.

4.2.2 Changes In Ownership

Ownership changes occur either because businesses do not have and are unable to borrow sufficient funds to purchase control equipment for the dry cleaning plant(s) they own or because after making the dry cleaning plant(s) they own compliant, revenues would be insufficient to meet legal financial obligations. Businesses in poor financial condition are projected to undergo a change of ownership unless they have sufficient cash to purchase required control equipment (because they are assumed to be unable to borrow money). Changes of this type result from capital availability constraints. Because none of the affected firms in below-average financial condition have adequate cash to purchase control devices (e.g., capital costs exceed cash reserves reported

TABLE 4-2. PROJECTED FINANCIAL RATIOS WITH REGULATION

	$75 to $100K Firms			Over $100K Firms		
Financial Ratio	Below Average	Average	Above Average	Below Average	Average	Above Average
Liquidity						
Current ratio	0.35	1.49	3.14	0.48	1.55	3.52
Activity						
Fixed asset turnover ratio	1.95	3.88	4.74	2.04	4.23	5.29
Leverage						
Debt ratio	60.00%	55.05%	30.69%	60.00%	52.76%	26.85%
Profitability						
Profit to sales	0.48%	4.80%	10.82%	0.85%	5.64%	11.66%
Profit to assets	0.69%	8.56%	22.63%	1.22%	10.47%	25.55%
Profit to net worth	1.72%	19.04%	32.66%	3.05%	22.16%	34.93%

Note:
Financial ratios are computed using data presented in Table 4-1.

in the balance sheet), these firms are projected to incur financial failure due to capital availability constraints.

Businesses in average or better financial condition can borrow money but may still experience a change in ownership if expected revenues are insufficient to cover baseline plus recurring regulatory costs--loan payments, recurring fixed control costs, and variable control costs. Ownership changes due to insufficient revenues are categorized as profitability impacts. None of the firms in this analysis are projected to incur profitability impacts that result in changes in ownership.

Table 4-3 presents the estimated changes in ownership due to the standards. All of these changes in ownership are due to capital availability impacts for firms in below average financial condition. Under Financial Scenario I where there are no potentially affected firms in below-average condition, the number of ownership changes is 0. Under Financial Scenario II, where 25 percent of the potentially affected firms are in below-average financial condition, ownership changes are projected to be 834.

The estimated number of ownership changes presented here is substantially higher than the estimated plant closures (259) presented in Section 3. At least two reasons explain this difference. First, as noted in Section 3, plant closures are estimated as net rather than gross closures while potential changes in ownership reflect gross plant closures. Second, ownership may change even if the facility doesn't close. Firms in poor financial condition may sell their affected dry cleaning facilities to another owner in better financial condition. In addition, ownership changes also include bankruptcies. Although bankruptcy may result in a plant closure, it may also simply result in a transfer of ownership to another owner without plant closure. If the owner(s) decides to sell the plant or ownership is transferred because of bankruptcy, a change in ownership occurred but the plant did not close. Consequently, estimated

TABLE 4-3. POTENTIAL CHANGES IN OWNERSHIP DUE TO THE STANDARDS

Annual Receipts Range ($000) and Type of Impact	Financial Scenario I	Financial Scenario II
75 to 100		
Capital Availability	0	165
Profitability	0	0
100 to 250		
Capital Availability	0	405
Profitability	0	0
250 to 500		
Capital Availability	0	170
Profitability	0	0
Over 500		
Capital Availability	0	94
Profitability	0	0
Total		
Capital Availability	0	834
Profitability	0	0

Notes:

1. Capital availability impacts are projected when firms in poor financial condition have insufficient funds to purchase the required control equipment. It is assumed that firms in poor financial condition cannot borrow funds.
2. Profitability impacts are projected when revenues are insufficient to cover the full costs of production including control costs.
3. Financial Scenario I assumes a positive correlation between firm size and financial condition. Financial Scenario II assumes no correlation between firm size and financial condition.

changes in ownership may reasonably be expected to exceed the estimated net plant closures.

REFERENCES

Abowd, John M. and Orley Ashenfelter. 1981. "Anticipated Unemployment, Temporary Layoffs, and Compensating Wage Differentials." In Studies in Labor Markets, pp 141-170. Sherwin Rosen, ed. Chicago, IL: University of Chicago Press.

Anderson, D. W., and Ram V. Chandran. 1987. "Market Estimates of Worker Dislocation Costs." Economics Letters. 24: 381-384.

Blinder, Alan S. 1988. "The Challenge of High Unemployment." Richard T. Ely Lecture printed in the American Economic Review 78(2):1-15.

Duns Analytical Services. 1990. Industry Norms and Key Business Ratios. Dun and Bradstreet Business Credit Services. 1989-1990.

Fisher, William. March 6, 1990. Telecon. International Fabricare Institute. Personal communication with Brenda L. Jellicorse, Research Triangle Institute.

Flaim, Paul O. 1984. "Unemployment in 1982: The Cost to Workers and Their Families." Monthly Labor Review Feb.:30-37

Gordon, Robert J. 1978. Macroeconomics. pp. 271-275. Boston: Little Brown and Company.

Hamermesh, Daniel S. 1989. "What Do We Know About Worker Displacement in the U.S.?" Industrial Relations 28(1):51-59.

Maxwell, Nan L. 1989. "Labor Market Effects from Involuntary Job Losses in Layoffs, Plant Closings: The Role of Human Capital in Facilitating Reemployment and Reduced Wage Losses." American Journal of Economics and Sociology 48(2):129-141.

Moore, Michael J. and W. Kip Viscusi. 1990. Compensation Mechanics for Job Risks. Princeton, NJ: Princeton University Press.

Radian Corporation. 1990. "National Cost Impacts of Regulatory Alternatives for the Hazardous Air Pollutant Dry Cleaning NESHAP." Memorandum from Carolyn Norris and Kim Kepford to U.S. Environmental Protection Agency, Chemical and Petroleum Branch. January 25.

Radian Corporation. 1993. "Annual Respondent Burden and Cost of Reporting and Recordkeeping Requirements of the Promulgated Standard." Memorandum from Carolyn Norris to Brenda Jellicorse, Research Triangle Institute, Research Triangle Park, NC. June 2.

Sherer, F. M. 1980. Industrial Market Structure and Economic Performance. 2nd ed., Chicago: Rand McNally College Publishing Company.

Topel, Robert H. 1984. "Equilibrium Earnings, Turnover, and Unemployment: New Evidence." Journal of Labor Economics 2(4):500-522.

U.S. Department of Labor, Bureau of Labor Statistics. 1991. Employment and Earnings. Washington, DC: U.S. Government Printing Office. April.

U.S. Environmental Protection Agency. 1991. Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry. Final report prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, EPA 450/3-91-021.

Appendix A

Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

October 1991

Air

EPA

Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry

Draft

NESHAP

Economic Impact Analysis of Regulatory Controls in the Dry Cleaning Industry

Emission Standards Division

U.S. Environmental Protection Agency
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711
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SECTION 1

INTRODUCTION AND SUMMARY

Under the Clean Air Act Amendments of 1990, the U.S. Environmental Protection Agency (EPA) is required to propose and promulgate a regulation to control Hazardous Air Pollutant (HAP) emissions from dry cleaning facilities. HAP's emitted from dry cleaning include perchloroethylene (PCE) and 1,1,1-Trichloroethane (1,1,1-TCA). This report investigates the economic impacts associated with three candidate regulatory alternatives and five size cutoff levels considered for proposal. All plants that use 1,1,1-TCA are in compliance with the proposed regulatory alternatives in the baseline. No costs or economic impacts are projected for these facilities. Therefore, the analysis of regulatory controls addresses impacts associated with the control of PCE emissions only.

This section provides a brief overview of the dry cleaning industry and the impacts of the regulatory alternatives discussed in detail in the balance of the report. A description of supply and demand for dry cleaning services is provided in Sections 2 and 3, respectively. Section 4 describes market structure and outlines an approach for analyzing market impacts of the regulatory alternatives. The baseline financial profile of dry cleaning firms is provided in Section 5. Section 6 describes the requirements of the candidate regulatory alternatives and outlines potential responses to the regulatory alternatives. Section 7 reports projected economic and financial impacts associated with each regulatory alternative and Section 8 summarizes the analysis.

The dry cleaning industry is comprised of three sectors: commercial (SIC 7216), coin-operated (SIC 7215), and industrial (SIC 7218). Commercial facilities are the most prevalent of the three types and are generally located in shopping centers and near densely populated areas. Coin-operated plants are typically part of a laundromat and provide dry cleaning either on a self-service basis or by accepting items over the counter--similar to commercial facilities. Industrial plants usually rent uniforms and other items to their industrial or commercial users and are generally larger than commercial and coin-operated facilities.

It is important to distinguish between the terms machine, facility, plant, establishment, and firm used to describe the dry cleaning industry in this analysis. A dry cleaning machine is a piece of equipment designed to clean clothes or other items using a solvent mixture in place of water and detergent. The terms facility, plant, and establishment are used interchangeably and refer to a single physical location where dry cleaning services are produced. Each facility may use one or more dry cleaning machines in the production process. A dry cleaning firm is a legal entity that owns one or more dry cleaning facilities.

Approximately 34,000 facilities offer dry cleaning services in the United States. Of these, about 28,000 use PCE in their cleaning process. The commercial sector comprises approximately 90 percent of the industry with an estimated 30,494 dry cleaning plants; 24,947 of these plants use PCE. The industrial sector has 1,379 total plants, but only about 325 have dry cleaning capacity. Approximately 40 percent, or 130, use PCE in their dry cleaning operation. The U.S. has 27,180 coin-operated laundries. Of these 27,180 plants, an estimated 3,044 offer dry cleaning services. Table 1-1 summarizes the total number of plants, the number of dry cleaning plants, and the number of dry cleaning plants that use PCE by industry sector. In addition, the number of potentially affected plants and potentially affected firms are reported in Table 1-1. Potentially affected entities include those that use PCE in the dry cleaning process and do not have the control equipment required under the most stringent regulatory scenario (Regulatory Alternative III with no cutoff). Potentially affected firms include those business entities that own potentially affected facilities.

The three regulatory alternatives under consideration for proposal specify control equipment requirements for facilities by industry sector and machine technology. An estimated 65 percent of dry cleaning plants or 21,954 have some type of baseline control equipment in place. The 11,909 facilities that do not have baseline control equipment in place would potentially incur control costs under any of the alternatives considered. An additional 1,930 facilities have control equipment that does not meet the requirements of Regulatory Alternative III. Therefore, under the most stringent regulatory scenario, 13,839 facilities would be affected.

TABLE 1-1. ESTIMATED NUMBER OF DRY CLEANING PLANTS BY INDUSTRY SECTOR (1991)[a]

Sector	Total Number of Plants[b]	Number of Dry Cleaning Plants[c]	Number of PCE Dry Cleaning Plants	Number of Potentially Affected Plants[d]	Number of Potentially Affected Firms[e]
Commercial	30,494	30,494	24,947	12,159	10,744
Coin-Operated	27,180	3,044	3,044	1,615	e
Industrial	1,379	325	130	65	e
Total	59,053	33,863	28,121	13,839	e

[a]Includes facilities with payroll and those without payroll.

[b]Includes plants in the coin-operated and industrial sectors that have dry cleaning machines and those that do not have dry cleaning machines.

[c]Includes dry cleaning plants that use PCE as well as those that use other solvents.

[d]Includes PCE plants that do not have vent controls required under the most stringent regulatory scenario (Regulatory Alternative III with no cutoff).

[e]Includes firms that own potentially affected plants. The number of potentially affected firms that own coin-operated or industrial plants is not estimated for this analysis. Coin-operated plants will likely be exempt from the regulation and industrial plants are expected to realize cost-savings under each regulatory alternative considered. Therefore a firm financial analysis is not performed for the coin-operated or industrial sectors.

Source: Radian (1991c); 1987 Census of Service Industries, Nonemployer Statistics Series (U.S. Department of Commerce, 1990a); 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990b); Table 7-3.

Many facilities in the commercial and coin-operated sectors that are potentially affected by the regulation are small establishments. It is estimated that over 75 percent of potentially affected facilities receive less than $100,000 in annual receipts[1]. The annualized control costs associated

[1]Approximately 55 percent of affected machines represent output levels corresponding to $100,000 or less. The difference in the distribution of affected machines and affected facilities is attributable to two assumptions used to estimate impacts. First, it is assumed that uncontrolled machines represent a larger share of lower income categories and a smaller share of higher income categories. Second, it is assumed that facilities with over $100,000 in annual receipts use multiple machines in their operations whereas facilities below $100,000 receipts use only one machine.

with the regulatory alternatives range from $1,500 to $8,000 per plant. For small facilities below $25,000 in annual receipts, these control costs may represent more than one third of total receipts to the facility. To mitigate the impacts on small facilities, size cutoffs based on PCE usage are considered. These cutoffs correspond to target levels of annual receipts and exempt facilities below a specified output level. Figure 1-1 shows the number of affected facilities under each size cutoff by Regulatory Alternative. Note that the number of affected facilities under each size cutoff is identical for Alternatives I and II.

Because thousands of facilities in the dry cleaning industry are potentially affected, analyzing regulatory impacts using a facility-specific approach is not feasible. Therefore, a model plant approach based on fifteen model plants that characterize the machine technology, machine capacity, and operating practices of typical dry cleaning machines is used to estimate impacts in the industry. Within each model plant category, impacts are analyzed for plants operating at five output levels based on annual receipts. Furthermore, impacts are analyzed using a model market approach that differentiates the market for dry cleaning services by the number of facilities in the market, the share of affected and unaffected facilities in the market, and the projected behavioral response to the regulation. Eight model markets are used to represent market conditions and market structure in the dry cleaning industry including six model markets for the commercial sector, one model for the coin-operated sector, and one model for the industrial sector.

Regulatory impacts are projected using an integrated approach that combines an economic impact analysis with a firm financial analysis. In the economic impact analysis a methodological and empirical approach based on the principles of applied welfare economics is used. Economic impacts are quantified through estimated market adjustments of price and output and corresponding effects on consumer and producer welfare. The price and output adjustments computed in this analysis are short-run effects. Almost all new dry cleaning machines are equipped with built-in vent controls that satisfy the requirements of the regulations. The current stock of uncontrolled

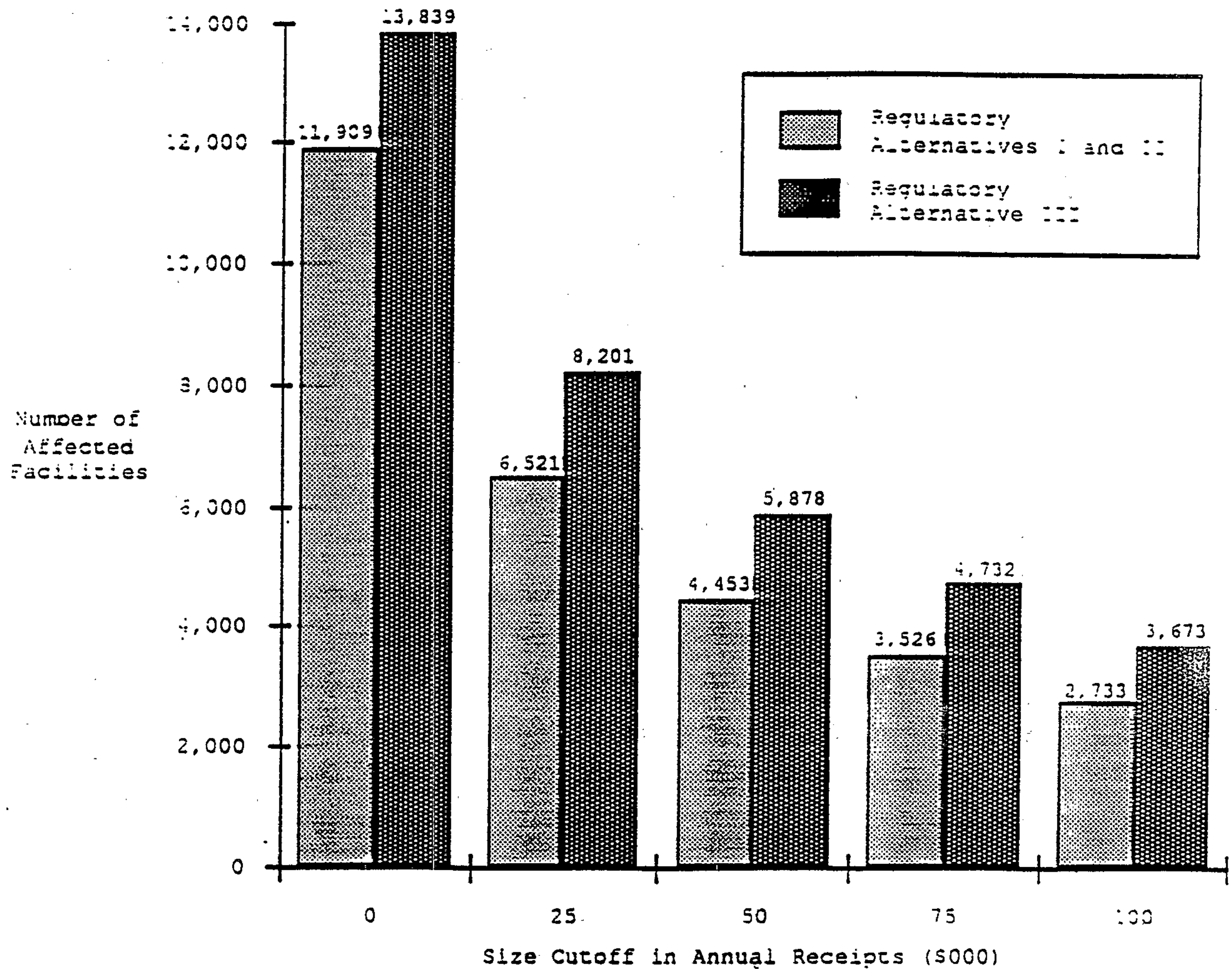

Figure 1-1. Number of Affected Dry Cleaning Facilities By Regulatory Alternative and Size Cutoff

Source: Tables 7-2 and 7-3.

machines would have been replaced with controlled machines even in the baseline. Consequently, long-run price and output adjustments are zero. In addition, the effects of the candidate regulatory alternatives on employment and plant closures are quantified as part of the economic impact analysis. Financial impacts including capital availability and profitability impacts are projected recognizing that firms differ by size and baseline financial health.

Table 1-2 reports the annualized costs, the producer welfare costs, and the consumer welfare costs for the industry as a whole under each regulatory alternative and size cutoff level. The annualized costs include the annual operating costs of control equipment along with the annualized installed costs of the equipment. The producer and consumer welfare costs are those projected for the first year of the regulation. Lesser losses will be incurred in fourteen subsequent years because existing uncontrolled machines are being replaced with controlled machines upon retirement, even at baseline. Fifteen years after the regulation takes effect, producer and consumer welfare costs are zero assuming that the current stock of uncontrolled machines would be replaced with controlled machines in the baseline over this time period.

Table 1-3 reports the projected worst-case net plant closures, projected worker displacements, and worker displacement costs for the industry as a whole under each regulatory alternative and size cutoff level. The plant closure projections assume that the short-run industry output reductions are achieved by closure of the smallest size facilities. The projected worker displacements assume that layoffs are proportional to the short-run industry output reductions. The projected worker displacement costs are based on the projected displacements and are one-time (non-recurring) costs. Assuming (as described above) that the long-run equilibrium level of dry cleaning services is unaffected by the regulation, the long-run equilibrium employment will likewise be unaffected. The output reduction used to estimate worker displacement and displacement costs would have occurred in the baseline over an estimated 15-year time period as owners of dry cleaning facilities replaced retiring uncontrolled machines with controlled machines. Implicit in the estimated displacement costs is the assumption that this baseline output

TABLE 1-2. ANNUALIZED COSTS AND WELFARE IMPACTS OF THE DRY CLEANING NESHAP BY REGULATORY ALTERNATIVE AND SIZE CUTOFF ($1989)[a]

Cost or Impact Measure and Regulatory Alternative	Size Cutoff in Annual Receipts ($000) 0	25	50	75	100
Annualized Costs ($$10^6$)					
Regulatory I	34.8	18.9	13.3	11.1	9.1
Regulatory II	42.9	23.5	16.5	13.9	11.5
Regulatory III	53.5	33.0	24.8	21.3	17.7
Consumer Welfare Impacts ($$10^6$)					
Regulatory I	-14.6	-10.8	-7.7	-6.5	-5.3
Regulatory II	-18.0	-13.5	-9.5	-8.1	-6.7
Regulatory III	-20.3	-15.8	-11.5	-9.9	-8.2
Producer Welfare Impacts ($$10^6$)					
Regulatory I	-20.2	-8.0	-5.6	-4.6	-3.8
Regulatory II	-25.0	-10.0	-7.0	-5.9	-4.8
Regulatory III	-33.3	-17.2	13.3	-11.5	-9.5

[a]Annualized Costs and producer and consumer welfare losses incurred in first year of regulation. Costs will be incurred in subsequent years but will decline over time. Recurring annual costs will be zero 15 years after the effective date of the regulation assuming that the current stock of uncontrolled machines would be replaced by controlled machines in the baseline over this time period.

reduction--and corresponding reduction in employment--would have been accounted for through attrition rather than worker dislocation. In other words, the present value of foregone future displacement is assumed to be zero.

The firm financial analysis uses the costs estimated for the economic impact analysis to project changes in the financial viability of dry cleaning firms affected under each regulatory alternative. Estimated costs of capital are developed for firms in poor, average, and good financial condition.

TABLE 1-3. PROJECTED WORST-CASE NET PLANT CLOSURES AND EMPLOYMENT EFFECTS OF THE DRY CLEANING NESHAP

Impact Measure and Regulatory Alternative	Size Cutoff in Annual Receipts ($000)				
	0	25	50	75	100
Worst-Case Net Plant Closures[a]					
Regulatory I	1,354	373	147	88	23
Regulatory II	1,599	457	182	110	28
Regulatory III	1,768	529	221	135	34
Number Worker Displacements[b]					
Regulatory I	743	566	407	336	283
Regulatory II	920	707	513	424	354
Regulatory III	1,043	831	619	513	424
Worker Displacement Costs ($$10^6$)[c]					
Regulatory I	21.4	16.3	11.7	9.7	8.2
Regulatory II	26.5	20.4	14.8	12.2	10.2
Regulatory III	30.0	23.9	17.8	14.8	12.2

[a]Net plant closures assuming all industry output reductions are achieved by closures of smallest affected facilities.
[b]Assumes labor demand declines in proportion to equilibrium output reductions.
[c]One-time (non-recurring) worker displacement cost. The present value of foregone future displacement is assumed to be zero.

Capital availability constraints and profitability impacts are reported for firms in the commercial sector that are affected under each regulatory alternative. Figure 1-2 shows the potential changes in ownership by size cutoff level under the regulatory alternatives assuming a positive relationship between firm size and baseline firm financial condition, as might be expected since smaller firms generally have significantly lower capacity utilization than larger firms (financial scenario I).

Potential changes in firm ownership under an alternative assumption are demonstrated in Figure 1-3. These projected impacts might result if the number of firms in below-average, average, and above-average baseline financial condition are proportionately distributed across firms of all sizes (financial scenario II).

The total annualized cost ranges from $53.5 million under the most stringent regulatory scenario to less than $10 million under the least stringent. The estimated regulatory costs result in short-run price and output adjustments that are relatively small (less than one percent deviation from baseline values in most cases). The estimated loss in consumer welfare ranges from $14.6 to $20.3 million with no cutoff. Producers lose an estimated $20.2 to $33.3 million in welfare with no cutoff. In addition, more than 3,000 potential changes in ownership are projected with no size cutoff. However, the size cutoffs would mitigate the economic and financial impacts of the regulatory alternatives. For example, with a cutoff level corresponding to $100,000 annual receipts, consumer and producer welfare impacts under Alternative II are $6.7 million and $4.8 million, respectively, and projected changes in ownership are between 0 and 669.

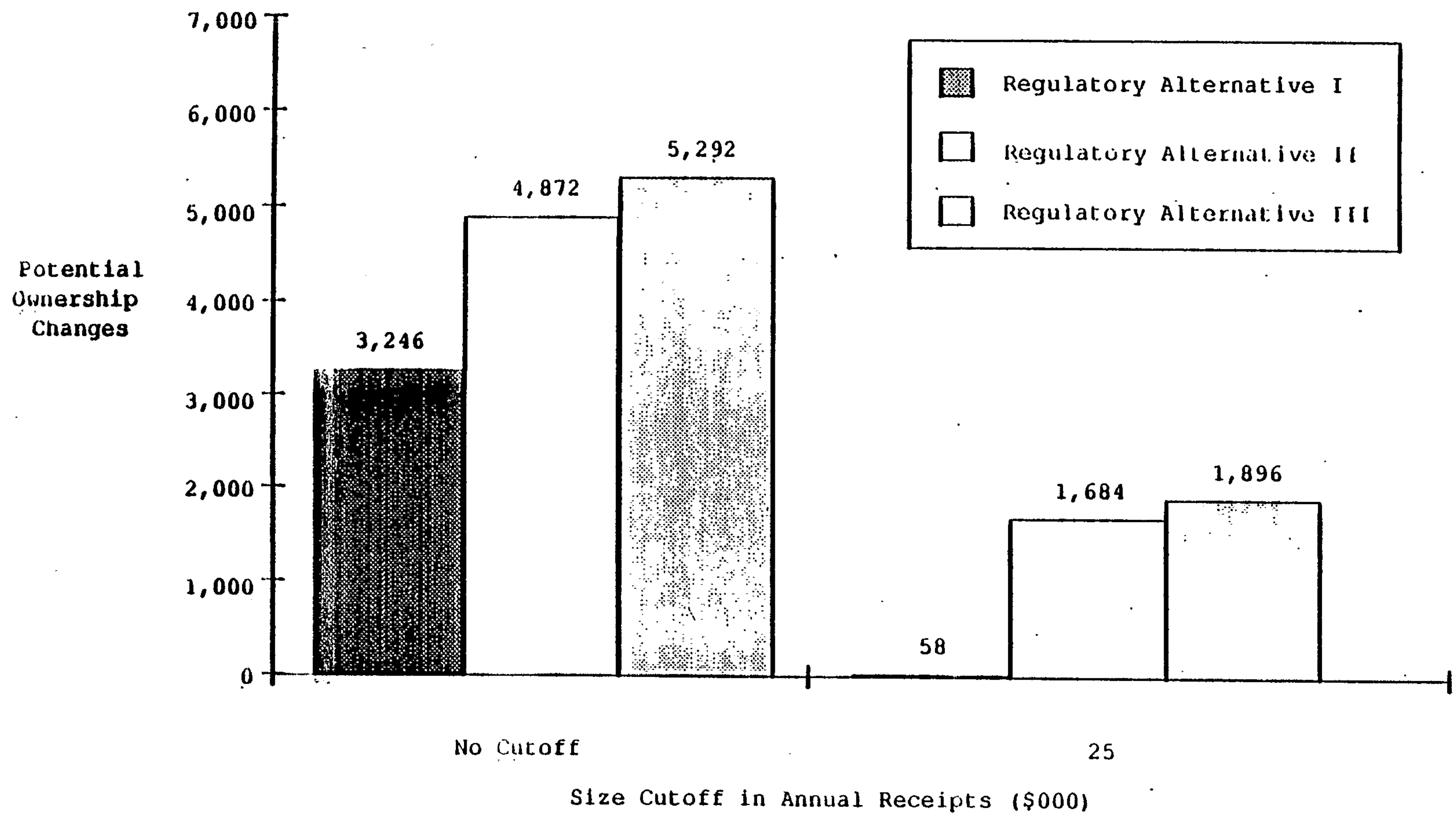

Figure 1-2. Potential Changes in Ownership by Size Cutoff, Financial Scenario 1

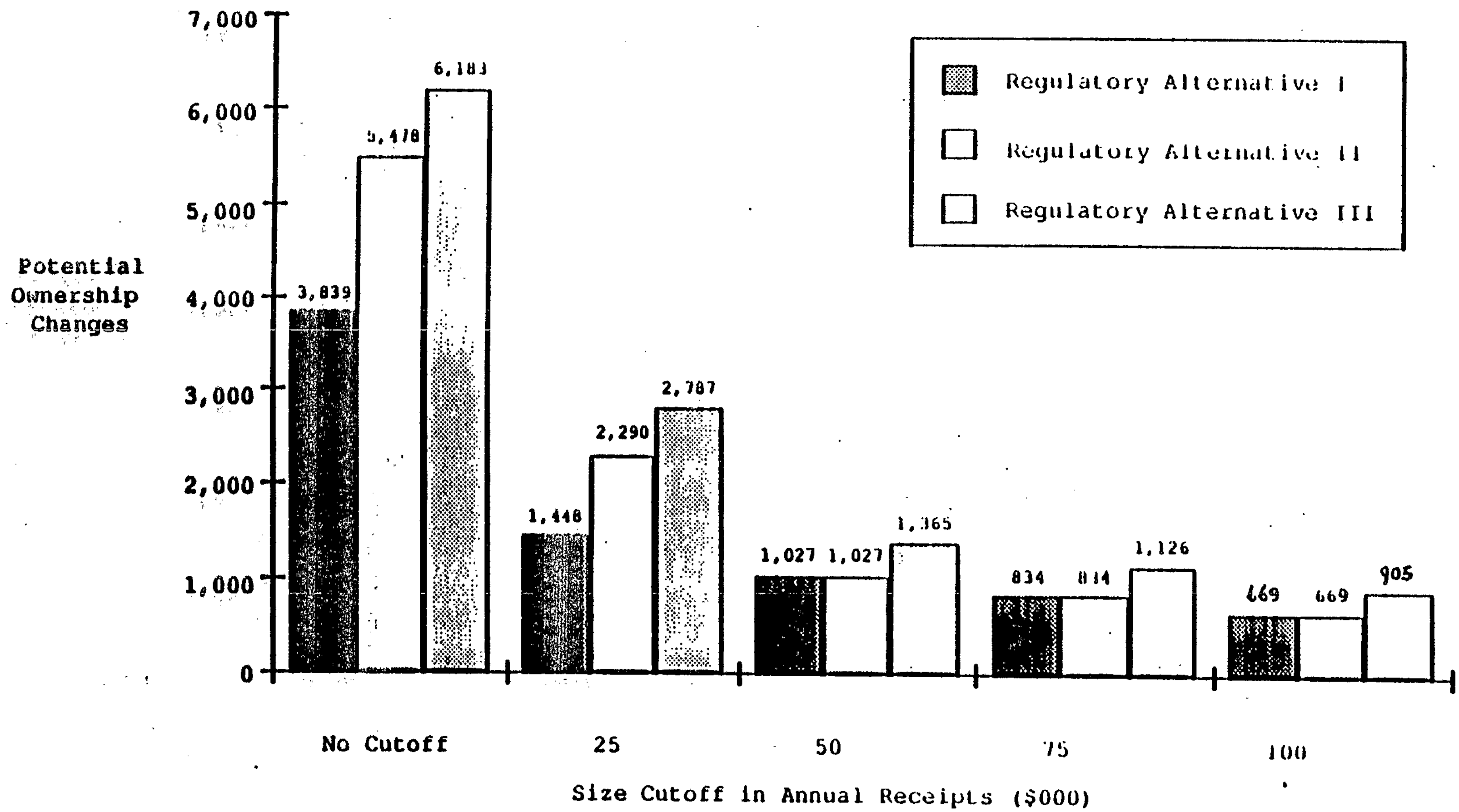

Figure 1-3. Potential Changes in Ownership by Size Cutoff, Financial Scenario II

SECTION 2

SUPPLY OF DRY CLEANING SERVICES

The dry cleaning industry is a mature service industry involved in the cleaning, pressing, and finishing of clothing and related products. This section provides a profile of each sector of the industry, production history and trends, an overview of the production process, and the estimated costs of production.

2.1 PROFILE OF SUPPLIERS BY INDUSTRY SECTOR

The dry cleaning industry is composed of three sectors:

- commercial (SIC 7216),
- coin-operated (SIC 7215), and
- industrial (SIC 7218).

Commercial facilities are the most prevalent of the three types and are generally located in shopping centers and near densely populated areas. Coin-operated plants are typically part of a laundromat and provide dry cleaning either on a self-service basis or by accepting items over the counter--similar to commercial facilities. Industrial plants usually rent uniforms and other items to their customers and are generally larger than commercial and coin-operated facilities.

2.1.1 Commercial Sector

Commercial dry cleaning facilities, the most familiar type of establishment, provide services for households and include independently operated neighborhood shops, franchises, and specialty cleaners. Commercial dry cleaners provide full service dry cleaning, which includes spotting, pressing, finishing, and packaging. In addition, many commercial dry cleaners provide laundry services for water-washable garments, rug cleaning services, and minor alteration and repair services. On average approximately 85 percent of the receipts at a commercial dry cleaning establishment are from dry cleaning activities. The remaining 15 percent are from the auxiliary services provided by the facility (U.S. Department of Commerce, 1991).

Approximately 30,494 commercial dry cleaners operate in the U.S. Over 80 percent or about 24,947 commercial dry cleaners use perchloroethylene (PCE) in their cleaning process. Table 2-1 shows the distribution of PCE establishments, the distribution of PCE machines, and the corresponding number of machines per facility for 5 income categories (based on annual receipts per facility). This estimated total number of dry cleaning facilities and the distribution of facilities by income level is based on the number and distribution of PCE dry cleaning machines by design capacity, the average number of machines per facility in the commercial sector (approximately 1.25) (Radian 1990c), and the distribution of facilities reported in the 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990b). In addition, it is assumed that facilities below $100 thousand in annual receipts have one machine per facility.

Tables 2-2 and 2-3 show the 1991 distribution of annual receipts for all commercial establishments and for establishments that use PCE, respectively. Over three fourths of the total receipts to dry cleaning establishments were earned by facilities with $100,000 or more in annual receipts. These facilities represent only about one third of the total number of commercial dry cleaning establishments. At the other end of the spectrum, small facilities with below $25,000 in annual receipts account for more than 25 percent of the total number of facilities but only about 3 percent of total receipts to commercial dry cleaners.

Dry cleaning output for the sector totals 571,984 Mg per year with 446,492 Mg from facilities that use PCE. Total output is computed by first multiplying total annual receipts by the share of receipts from dry cleaning activities (85%) to compute the receipts directly attributable to drycleaning. This value is then divided by the estimated 1989 baseline price of $6.34 per kilogram for dry cleaning services to compute total annual output measured in kilograms of clothes cleaned. Tables 2-4 and 2-5 report 1991 estimated total output and average output per establishment by income category.

TABLE 2-1. DISTRIBUTION OF PCE DRY CLEANING MACHINES AND FACILITIES IN THE COMMERCIAL SECTOR

Annual Receipts ($000/yr)	Number of PCE Machines	PCE Machines Per Establishment	Number of PCE Establishments	Number of PCE and non-PCE Establishments[a]
0 - 25	6,822	1	6,822	8,026
25 - 50	4,270	1	4,270	5,024
50 - 75[b]	2,632	1	2,632	3,096
75 - 100[b]	2,632	1	2,632	3,096
over 100	15,076	1.75	8,591	11,251
Total	31,432	1.26	24,947	30,494

[a]The total number of dry cleaning facilities in each income category is computed based on the assumption that 85 percent of dry cleaning machines use PCE (Safety Kleen, 1986). Note that the number of machines per establishment refers to PCE machines only. It is assumed the average number machines per establishment is one for all non-PCE establishments.

[b]Census data do not subdivide facilities with annual receipts between $50 and $100 thousand. For the purposes of analysis it is assumed that one half of facilities with $50 to $100 thousand annual receipts are below $75 thousand and one half are above $75 thousand.

Source: Radian, 1990c; 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990); Safety-Kleen, 1986.

TABLE 2-2. 1991 DISTRIBUTION OF RECEIPTS FOR COMMERCIAL DRY CLEANING ESTABLISHMENTS: PCE AND NON-PCE ESTABLISHMENTS ($1989)

Annual Receipts ($000/yr)	Number of Establishments[a]	Percent	Total Annual Receipts[b] ($000/yr)	Percent	Average Annual Receipts Per Establishment[c] ($/yr)
0-25	8,026	26.32	142,350	3.34	17,736
25-50	5,024	16.47	203,679	4.77	40,545
50-75	3,096	10.15	207,528	4.86	67,021
75-100	3,096	10.15	290,539	6.81	93,829
>100	11,251	36.90	3,421,966	80.21	304,135
Total	30,494	100.00	4,266,062	100.00	–

[a]See Table 2-1.
[b]Average annual receipts multiplied by number of establishments.
[c]Based on data reported in the 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990) for commercial dry cleaning establishments with payroll converted to $1989 using the CPI for Apparel and Upkeep.

TABLE 2-3. 1991 DISTRIBUTION OF RECEIPTS FOR COMMERCIAL DRY CLEANING ESTABLISHMENTS: PCE ESTABLISHMENTS ONLY ($1989)

Annual Receipts ($000/yr)	Number of Establishments[a]	Percent	Total Annual Receipts[b] ($000/yr)	Percent	Average Annual Receipts Per Establishment[c] ($/yr)
0-25	6,822	27.35	120,998	3.63	17,736
25-50	4,270	17.12	173,127	5.20	40,545
50-75	2,632	10.55	176,399	5.30	67,021
75-100	2,632	10.55	246,958	7.42	93,829
>100	8,591	34.44	2,612,824	78.46	304,135
Total	24,947	100.00	3,330,305	100.00	–

[a]See Table 2-1.
[b]Average annual receipts multiplied by number of establishments.
[c]Based on data reported in the 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990) for commercial dry cleaning establishments with payroll converted to $1989 using the CPI for Apparel and Upkeep.

TABLE 2-4. 1991 DISTRIBUTION OF DRY CLEANING OUTPUT IN THE COMMERCIAL SECTOR: PCE AND NON-PCE ESTABLISHMENTS

Annual Receipts ($000/yr)	Number of Establishments[a]	Percent	Total Annual Output[b] (Mg/yr)	Percent	Average Annual Output Per Establishment[b] (kg/yr)
0-25	8,026	26.32	19,085	3.34	2,378
25-50	5,024	16.47	27,307	4.77	5,436
50-75	3,096	10.15	27,823	4.86	8,985
75-100	3,096	10.15	38,952	6.81	12,580
>100	11,251	36.90	458,781	80.21	40,775
Total	30,494	100.00	571,948	100.00	—

[a]See Table 2-1.
[b]Receipts from Table 2-2 multiplied by the share of receipts from dry cleaning activities (85%) divided by the 1989 base price ($6.34 per kg).

TABLE 2-5. 1991 DISTRIBUTION OF DRY CLEANING OUTPUT IN THE COMMERCIAL SECTOR: PCE ESTABLISHMENTS ONLY

Annual Receipts ($000/yr)	Number of Establishments[a]	Percent	Total Annual Output[b] (Mg/yr)	Percent	Average Annual Output Per Establishment[b] (kg/yr)
0-25	6,822	27.35	16,222	3.63	2,378
25-50	4,270	17.12	23,211	5.20	5,436
50-75	2,632	10.55	23,650	5.30	8,985
75-100	2,632	10.55	33,110	7.42	12,580
>100	8,591	34.44	350,300	78.46	40,775
Total	24,947	100.00	446,492	100.00	—

[a]See Table 2-1.
[b]Receipts from Table 2-3 multiplied by the share of receipts from dry cleaning activities (85%) divided by the 1989 base price ($6.34 per kg).

The commercial sector baseline price is derived using International Fabricare Institute (IFI) data on the average price to clean a two-piece man's suit weighing one kilogram (Faig, 1990). Control cost estimates and other financial data used in the economic impact analysis are measured in 1989 dollars. However, the most recent base price estimate available for the commercial sector is the average 1988 value ($5.92). The 1989 base price was projected by first fitting a regression line to the natural logarithm of base prices from 1973 to 1988 and a time trend. The slope of the regression line (0.0707) is an estimate of the average growth rate of base prices over that time period.

The projected 1989 base price is then calculated as the sum of the 1988 price plus the growth amount:

$$\begin{aligned} P_{1989} &= P_{1988} \cdot (1 + 0.0707) \\ &= \$5.92 \cdot (1 + 0.0707) \\ &= \$6.34 \end{aligned} \tag{2.1}$$

For the purposes of analysis, all facilities are assumed to charge $6.34 per kilogram of clothes cleaned in the baseline. In following sections, price changes due to the regulation are projected based on the price computed in this section.

2.1.2 Coin-operated Sector

Facilities in the coin-operated sector also supply dry cleaning services to households and are usually part of a laundromat. Water washing and drying account for the majority of sales with dry cleaning offered as an auxiliary service (Torp, 1990). Approximately 10 percent of total receipts at coin-operated laundries that offer dry cleaning services are from dry cleaning activities.

Two types of dry cleaning services are available in this sector: self-service and employee assisted dry cleaning. Self-service, coin-operated dry cleaning, as the name suggests, requires the consumer to operate the dry cleaning machine and does not include pressing, spotting, or other finishing services. Employee assisted dry cleaning (referred to as plant-operated in the balance of this report) is virtually indistinguishable from the service provided by commercial dry cleaners except that the facility also offers coin-operated laundry services. Consumers use coin-operated dry cleaners because they desire lower priced cleaning, have large items, or do not live near commercial cleaners (ICF, 1986).

Census data indicate that 27,180 coin-operated laundries--including facilities with and without payroll--were operating in the U.S. in 1987 (U.S. Department of Commerce, 1990a). Approximately 3,044 coin-operated laundries offer dry cleaning services. About 2,831 establishments offer plant-operated dry cleaning and another 213 establishments offer self-service dry cleaning (Radian, 1991c). Virtually all coin-operated laundries that offer dry cleaning services use PCE in the cleaning process.

Table 2-6 shows the 1991 distribution of coin-operated establishments with dry cleaning operations. The income distribution is based on the income distribution of all coin-operated laundries with payroll including those without dry cleaning capacity (U.S. Department of Commerce, 1990b). Establishments with over $100,000 in annual receipts account for approximately 14 percent of the establishments and more than half of the receipts at plants with dry cleaning operations. Establishments that collect less than $25,000 in annual receipts account for about 17 percent of the plants and less than 4 percent of receipts at plants with dry cleaning operations. Nearly one half of all plants in this sector with dry cleaning operations are in the $25 to $50 thousand receipts range.

TABLE 2-6. 1991 DISTRIBUTION OF RECEIPTS FOR COIN-OPERATED ESTABLISHMENTS WITH DRY CLEANING CAPACITY ($1989)

Annual Receipts ($000/yr)	Number of Establishments[a]	Percent	Total Annual Receipts[b] ($000/yr)	Percent	Average Annual Receipts Per Establishment[c] ($/yr)
0-25	523	17.19	9,248	3.61	17,683
25-50	1,451	47.70	58,706	22.93	40,459
50-75	475	15.61	31,835	12.43	67,021
75-100	169	5.49	15,669	6.12	93,829
>100	426	14.00	140,571	54.90	329,978
Total	3,044[d]	100.00	256,029	100.00	—

[a]The distribution of establishments is based on the distribution of all coin-operated laundries with payroll (including those without dry cleaning capacity) reported in the 1987 Census of Service Industries (U.S. Department of Commerce, 1991b).
[b]Average annual receipts multiplied by the number of establishments.
[c]Based on data reported in the 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990) for coin-operated laundries with payroll converted to $1989 using the CPI for Apparel and Upkeep.
[d]Radian 1991a.

Projected 1991 annual receipts to coin-operated laundries with dry cleaning operations total $256 million. However, only about 10 percent or $25.6 million in receipts are directly from dry cleaning activities in the coin-operated sector. Dry cleaning output for this sector totals 4,298 Mg per year. Output is computed based on an average price of $6.34 per kilogram of clothes cleaned at plant-operated facilities and $1.65 per kilogram for self-service facilities. Table 2-7 shows the total dry cleaning output and the average output per establishment by income category for the coin-operated sector.

TABLE 2-7. 1991 DISTRIBUTION OF DRY CLEANING OUTPUT IN THE COIN-OPERATED SECTOR

Annual Receipts ($000/yr)	Number of Establishments[a]	Percent	Total Annual Output[b] (Mg/yr)	Percent	Average Annual Output Per Establishment[b] (kg/yr)
0-25	523	17.19	179	4.01	343
25-50	1,451	47.70	1,138	25.47	784
50-75	475	15.61	616	13.79	1,297
75-100	169	5.49	317	7.10	1,878
>100	426	14.00	2,217	49.62	5,205
Total	3,044[c]	100.00	4,468	100.00	—

[a]The distribution of establishments is based on the distribution of all coin-operated laundries with payroll (including those without dry cleaning capacity) reported in the 1987 census of service industries (U.S. Department of Commerce, 1991b).
[b]Receipts from Table 2-6 multiplied by the share of receipts from dry cleaning activities (10%) divided by the 1989 base price. Base price for coin-operated (self-service) is $1.65 per kg. Base price for coin-operated (plant-operated) is $6.34 per kg. See Table 2-13 for the share of plant-operated and self-service establishments in each receipts category.
[c]Radian 1991a.

Price information is unavailable for the coin-operated sector. Based on conversations with industry officials, plant-operated facilities probably charge the same price as commercial facilities or $6.34 per kilogram (Torp, 1990). A survey of two coin-operated facilities with self-service machines indicated that they both charge $6.00 to run one cycle in a 3.6 kilogram capacity machine. Presumably, these facilities are representative of the sector and $6.00 is the average price to use a 3.6 kilogram self-service coin-operated machine. Thus, the average price to clean one kilogram of clothing is calculated to be $1.65.

2.1.3 Industrial Sector

The industrial sector supplies items such as laundered uniforms, wiping towels, floor mats, and work gloves to industrial or commercial users. Industrial laundries provide services for a diverse group of industrial and commercial users including auto service and repair shops, food processing plants, manufacturing concerns, construction firms, hotels, restaurants, security firms, banks, and real estate companies. The commercial or industrial user usually rents the items from the industrial launderer who provides pick-up, laundry, and delivery services for the consumer on a regular basis (Coor and Grady, 1991).

Service agreements between the industrial launderers and their customers to provide clean uniforms generally specify the number of changes per employee and a schedule for delivery of the rented items. For example, the typical agreement for uniform rental specifies that the industrial launderer provide 11 changes of clothing per employee per week including 5 clean suits left with the customer, 5 dirty suits taken back to the laundry, and 1 transition suit (the garment worn by the employee of the customer firm at the time of delivery). Items are generally delivered and collected at the same time each week (Coor and Grady, 1991).

According to Census data 1,379 industrial laundry facilities with payroll were operating in 1987. Over 90 percent of these establishments receive annual receipts over $100 thousand (U.S. Department of Commerce, 1990b). For this analysis, it is assumed that all industrial launderers with dry cleaning capacity have annual receipts of over $100 thousand. Approximately 325 industrial launderers have dry cleaning capacity. Of these about 40 percent (or 130) use PCE and 60 percent (or 195) use petroleum (Sluizer, 1990).

Annual receipts for industrial facilities with dry cleaning capacity total approximately $977 million. On average, about 35 percent of the receipts at facilities with dry cleaning capacity are from dry cleaning activities with the balance from water washing or other activities. Using an average price of $2.00 per kilogram of clothes cleaned, the estimated total dry cleaning output from commercial facilities is 170,901 Mg per year.

Price data are unavailable for the industrial sector. Therefore, a small survey was conducted to determine the average price charged to provide one clean uniform weighing approximately one kilogram. Prices ranged from $1.75 to $2.25 per change. A representative from an industry trade association confirmed that these prices are representative of the prices charged in the industry (Sluizer, 1990). The midpoint of the range ($2.00) is assumed to be the average base price for the industry.

2.2 PRODUCTION HISTORY AND TRENDS

Although dry cleaning technology has existed for many years, the industry did not experience widespread expansion until the 1960's. A deep recession in the early 1970's eliminated part of the industry, but the late 1970's and early 1980's saw a resurgence of dry cleaners (Fischer, 1987).

During the 1950's, petroleum was the principle solvent in dry cleaning plants. The 1960's brought a shift toward chlorinated solvents (e.g., PCE, F-113) that has continued to the present. The main reason for the shift was the widespread implementation of fire codes during this period. In addition, an existing new source performance standard (NSPS) for petroleum-based dry cleaning restricts the use of this solvent in new facilities. Because none of the chlorinated solvents exhibit the flammable properties of petroleum, the large number of plants built in shopping malls and suburban areas since the 1960's has been based on chlorinated-solvent technology (ICF, 1986).

Currently, a vast majority of all dry cleaners use PCE. However, demand for PCE by the dry cleaning industry has been declining and is expected to continue to decrease slowly due to greater recycling and lower solvent emissions from equipment (Chemical Marketing Reporter, 1986). The economic incentive for self-imposed emission reductions and solvent recycling has persuaded several plants to install control devices and/or switch to more efficient machines voluntarily.

No direct measurement of the quantity of clothes dry cleaned per year is available for the dry cleaning industry. However, an estimate of aggregate output can be derived through the quotient of total receipts for dry cleaning activities and an average price per kilogram of clothes cleaned. Historical information on average base prices and total receipts is available only for the commercial sector; statistics compiled for the industrial and coin-operated sectors do not distinguish between those facilities that dry clean and those that launder with water. The base price in the commercial sector is the price charged to clean a standard two-piece men's suit weighing one kilogram. As seen in Table 2-8, the average base price and total annual receipts measured in 1989 dollars increased by over 50 percent from 1974 to 1988. Total output for the sector measured in kilograms of dry cleaned clothing declined from the mid 1970's to the early 1980's. From 1981 to 1988, dry cleaning output increased by approximately one third.

Table 2-9 presents annual growth rates for each sector of the dry cleaning industry. These estimates are based on machinery sales and are therefore broken down by machine type as well as sector. Other factors considered include machine life, current and historical sales data, and replacement rate of the machinery. Predictions indicate that the commercial sector will be the only sector to experience positive growth, at just over 2 percent per year. Both the industrial and coin-operated sectors are estimated to show negative annual growth rates of approximately 5 percent and 7 percent, respectively. These growth rates do not predict overall growth in output for the coin-operated and industrial sectors, because dry cleaning activities account for only a small portion of total output in these sectors.

Several factors have contributed to the trend away from coin-operated dry cleaning. Because of environmental regulations, consumers are increasingly aware of the hazards of operating coin-operated machinery and handling the cleaning solvents. The decline is also due in part to more expensive dry cleaning equipment, questionable returns on dry cleaning activities in this sector, and the necessity of hiring an attendant. These factors combine to make coin-operated dry cleaning operations unprofitable (Torp, 1990).

TABLE 2-8. ANNUAL RECEIPTS, AVERAGE BASE PRICE, AND TOTAL OUTPUT FOR COMMERCIAL DRY CLEANERS ($1989)[a]

Year	Total Annual Receipts ($\$10^6$/yr)[a]	Average Base Price ($/kg)[a]	Total Dry Cleaning Output (10^6 kg/yr)[b]
1974	2,692	4.02	570
1975	2,630	4.42	506
1976	2,623	4.46	499
1977	2,675	4.36	521
1978	2,825	4.87	493
1979	2,878	4.90	499
1980	2,975	5.32	475
1981	2,941	5.63	444
1982	3,517	5.72	522
1983	3,638	5.87	527
1984	3,694	5.98	525
1985	3,764	6.13	522
1986	4,390	6.14	608
1987	4,287	6.05	603
1988	4,265	6.08	596

[a]Includes receipts for facilities with payroll only. All dollar figures converted to 1989 dollars through the Consumer Price Index for Apparel and Upkeep.

[b]Total sales multiplied by share of receipts from dry cleaning activities (85%) divided by average base price per kg.

Source: Faig, 1990.

TABLE 2-9. ANNUAL GROWTH RATES BY MACHINE TYPE AND SECTOR (1986-1989)

Sector	Machine type: Dry-to-dry	Machine type: Transfer	Total
Commercial	9%	-7%	2%
Coin-Operated	-7%	N/A	-7%
Industrial	-3%	-5%	-5%

Note: Growth rates are estimates based on Section 114 information. Considered in these estimates were machine life, current sales data, replacement rate, and 5- and 10-year sales data. Total annual growth rate is weighted according to the machine populations in each sector.

Source: Radian, 1991a.

The negative growth rate in industrial dry cleaning reflects increased costs of dry cleaning due to state regulations as well as the advent of polyester/cotton and polyester/wool blends that made water washable fabrics feasible even for dress clothes. In the 1980's, industrial cleaning plants have moved away from dry cleaning their output and toward laundering with new detergent formulations. Between 1980 and 1985, the number of industrial facilities that dry cleaned clothing dropped by approximately 50 percent (ICF, 1986). Virtually all the garments currently processed by industrial launderers are water washable. However, some industrial launderers continue to dry clean at least a portion of their water washable garments because dry cleaning increases the life of the garment and enhances the garment's appearance (Coor and Grady, 1991). An estimated 92 percent of the garments cleaned by industrial facilities are laundered in water and detergent, and this percentage is expected to continue to increase (Sluizer, 1990).

2.3 PRODUCTION PROCESSES

Dry cleaning services generally include cleaning, pressing, and finishing articles of clothing and other related products. In all three sectors, the dry cleaning process is almost identical to laundering in water except that a solvent, such as PCE, is used in place of water and detergent. The coin-operated sector is the only one that does not regularly provide pressing and finishing services. The processes, machinery, and controls in each sector of the dry cleaning industry are detailed in this section.

2.3.1 Machine Types

Two types of machines are commonly used in the dry cleaning industry: dry-to-dry and transfer. Dry-to-dry machines combine washing and drying in one machine and, therefore, do not have a separate machine for drying. Transfer machines, like the traditional laundry machines for water washing, consist of separate machines for washing and drying.

Most dry cleaning plants have one or more attachments to their dry cleaning machine. These include solvent filters, distillers, and vent controls. Figure 2-1 shows the typical configuration of a dry cleaning

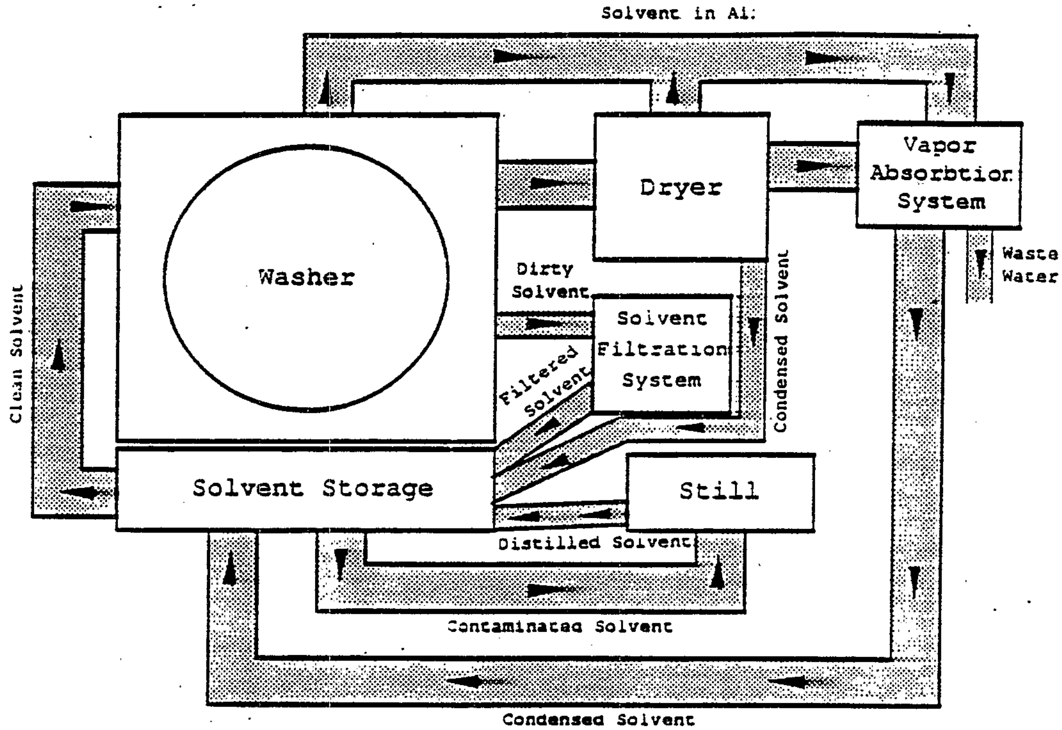

Figure 2-1. Typical Configuration of a Dry Cleaning Machine and the Various Attachments

Source: Safety-Kleen, 1986.

machine and the various attachments. Solvent filters remove impurities from the solvent and return the "clean" solvent to the solvent tank. Stills remove any impurities left in the solvent after it is filtered as well as water and detergent mixed with the solvent in the washing process through a distillation process. Virtually all dry cleaning facilities have solvent filtration systems and about 80 percent use stills. These devices extend the life of the solvent and reduce the amount of solvent that must be purchased (Safety-Kleen, 1986).

Approximately 60 percent of all PCE dry cleaning machines have vent control devices (Radian, 1991c). Vent controls are attached to the dryer and remove vaporized solvent from the dryer emissions. Vent control devices are available in two basic types: carbon adsorbers (CA's) and refrigerated condensors (RC's). With the use of a CA, PCE emissions are trapped in a carbon filter. The filter then undergoes a condensation process that eliminates the hazardous emissions. A typical CA lasts about 15 years and reduces emissions by about 95 percent when operated properly. The se... d type of control device, the RC, uses a refrigerated coil to cool PCE vapor: This cooling process results in condensation of PCE emissions. The average ..fe of a RC is about 7 years. The emission reduction achieved by RC's differ depending on the type of dry cleaning machine used. Refrigerated con... nsors reduce vent emissions by 85 percent on transfer machines and by about .5 percent on dry-to-dry machines.

Over 90 percent of new dry-to-dry machines built for the commercial and industrial sectors have built-in RC's (Federal Register, 1989). Add-on control devices may be purchased and attached to machines that are not equipped with vent controls from the manufacturer. A facility's selection of control devices is constrained by the capacity of its dry cleaning machine. Add-on RC's are not available for the very small machines built for the coin-operated sector or for the large machines built for the industrial sector. Both types of add-on devices are available to retrofit virtually all machines built for the commercial sector.

Owners and operators of dry cleaning facilities purchase add-on vent controls and attach them to their dryer for a variety of reasons. Some states require dry cleaners to control their emissions using a vent control device. Environmentally conscious owners may install vent controls even in the absence of state regulations. Depending on the price paid for solvent and the amount of solvent saved, some owners may realize a cost savings from reduced solvent consumption with a vent control.

2.3.2 Solvents

Four solvents are currently in use in the dry cleaning industry: PCE, fluorocarbon 113 (F-113), petroleum, and 1,1,1-trichloroethane (1,1,1-TCA). Of these four, PCE is usually considered the most efficient cleaner. Five main factors determine the suitability of a solvent for dry cleaning, each with a range of acceptable values, as opposed to an absolute standard (Busler, 1980):

- The solvent must be able to dissolve fats and oils without damaging the most common fibers and dyes.

- The solvent should not leave an unpleasant odor in garments after drying.

- Chemical stability is important to prevent damage to the metals used in dry cleaning machinery.

- A certain level of volatility is desirable to permit rapid drying and economical reclamation through distillation.

- The solvent should be compatible with common detergents used in the process.

The importance of PCE to the dry cleaning process depends on the ease with which it can be replaced by another comparable solvent. The potential for solvent substitution should be evaluated against the criteria established for the factors listed above.

F-113, petroleum, and 1,1,1-TCA can all theoretically be substituted for PCE in the dry cleaning process. However, none of these solvents will perform with the same degree of efficiency as PCE. Thus, an owner of a dry cleaning plant will need to ponder various considerations associated with solvent substitution. These factors include solvent prices, cleaning properties, capital costs, and operating costs. An additional factor in the substitution decision is the ease with which machinery designated for use with one solvent can be converted to accept other solvents.

Although all three alternative solvents are used in some dry cleaning plants, none are currently considered feasible for widespread substitution for PCE. F-113 most closely matches the cleaning abilities of PCE but is unsuitable for certain garments and stains. In addition, the possibility of regulations concerning ozone depletion may limit any immediate substitution. Finally, the unit price of F-113 is considerably higher than the unit price of PCE. Fire codes will probably prevent any substantial shift to petroleum, the second solvent. The remaining solvent, 1,1,1-TCA, has yet to attract much interest in this country. Its cleaning abilities are questionable because of high solvent aggressiveness and instability. In addition, usage costs are approximately ten times higher than for PCE (Fisher, 1990a) even though trichloroethane users can achieve energy savings of 5 to 10 percent (Fisher, 1987).

Technically, one other substitute for PCE is available. Industrial dry cleaners can switch to laundering garments with water and detergent for most items. The commercial and coin-operated sectors do not have this flexibility because the customer owns the item to be cleaned and, therefore, specifies the cleaning method.

Approximately 28,000 of the 34,000 dry cleaning plants in the United States use PCE as a cleaning solvent (see Table 2-1). Most of the remaining plants use a petroleum-based solvent, and a small percentage use either F-113 or 1,1,1-TCA. Approximately 85 percent of total dry cleaning output from commercial facilities is processed using PCE. Virtually all coin-operated facilities with dry cleaning capacity use PCE. Solvent use in the industrial sector is divided between PCE (40 percent) and petroleum (60 percent) (Sluizer, 1990).

Figure 2-2 shows the percentage of total PCE consumed by each sector. The commercial sector accounts for approximately 94.3 percent of total PCE consumption by the dry cleaning industry. The industrial sector and the coin-operated sector account for 4.6 percent and 1.1 percent of consumption, respectively.

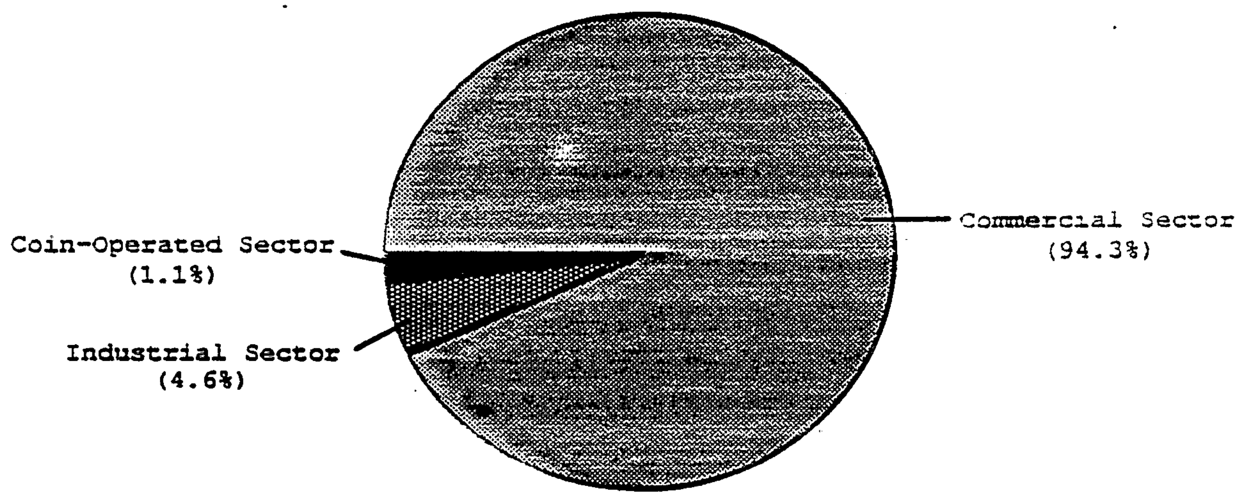

Figure 2-2. PCE Consumption by Sector for 1991
Source: Radian, 1990b.

2.3.3 Production Processes

The flow of production is basically identical in coin-operated (plant-operated) and commercial facilities. The production process begins when the dry cleaning plant receives the soiled garment from the consumer. After a garment enters the plant, a minimum of 10 steps of production are required to produce a clean garment ready for delivery. These steps of production are described below:

- Tagging--Tagging typically involves attaching a tag to the garment with a unique identification number for each customer. A record is made of the customer's name, the corresponding tag number, any special instructions, and the promised delivery date.

- Initial Classifying--Garments are separated into three basic categories at this stage of production: garments that require dry cleaning but no pre-spotting, garments that require laundering but no pre-spotting, and garments that require pre-spotting.

- Applying Spotting Chemicals--Garments stained with ink, paint, food, or other substances are treated with solvents and other compounds before they are laundered or dry cleaned.

- Further Classifying--Garments are further classified by the type of fabric and the color of fabric. This step is required because garments with different fabric types and colors require different treatment and can be damaged if they are processed with garments of dissimilar fabric type or color.

- Washing--In dry cleaning operations, garments are washed in a solvent mixture comprised of solvent, water, and detergent. The correct combination of solvent, water, and detergent and the correct washing temperature are vital to the successful removal of soil without damaging the garment. The washing step ends with extraction of the excess solvent mixture.

- Drying--After garments are washed and the excess moisture removed, they are dried using heated air. Garments may be transferred to a separate machine for drying (transfer machines) or dried in the same machine (dry-to-dry machines) used to wash the garments depending on the machine technology employed by the facility.

- Pressing and Finishing--Clean, dry garments are pressed and finished. Finishing includes replacing damaged or missing buttons, special pressing (e.g., pleated skirts), and any other special handling that may be required.

- Hanging--Garments are placed on hangers in this step of the production process.

- Assembling--After they are placed on hangers, garments are sorted and assembled by consumer identification number on the tag attached to the garment and by promised delivery date.

- Packaging--Assembled garments are packaged for delivery. Packaging typically involves placing a plastic bag over the garments.

Garments are inspected periodically throughout the process described above to determine the success in removing soil and the acceptability of the pressing and finishing steps. Additional steps may be required for heavily soiled garments, oversized items, or delicate garments that require special handling. The production process ends with delivery of the cleaned, pressed, packaged garments to the consumer.

Production of clean clothes at coin-operated (self-service) facilities involves the consumer as an active participant. The facility provides the equipment used in the washing and drying process and the individual provides the labor inputs required for the spotting, pressing, and finishing of the garment. The process of producing clean clothes is similar to that described above for commercial and coin-operated (plant-operated) facilities excluding the tagging, assembling, and packaging steps.

Unlike customers in the commercial or coin-operated sector, customers of industrial cleaners do not deliver the soiled items to the cleaning facility. Rather, the industrial cleaner collects the soiled items from the commercial or industrial user on a regular basis at no additional charge to the user.

The production process begins when the soiled garment enters the industrial plant. The steps of production are similar to those described above for commercial and coin-operated (plant-operated) facilities. A few differences do exist, however. Garments cleaned by industrial facilities generally contain a permanent identification number that identifies not only the company purchasing the dry cleaning service but also the individual that actually wears the garment, the route number, and the day of the week scheduled for delivery of the cleaned items. The process generally requires less classifying beyond the initial classifying because garments are more homogeneous with regard to fabric type and color. In addition, the process is generally more mechanized and larger in scope than the process at a typical commercial or coin-operated (plant-operated) facility. The production process ends with the delivery of the cleaned item to the customer on the promised delivery date.

2.4 COSTS OF PRODUCTION

Costs of production in the dry cleaning industry can be classified as either fixed or variable costs. Fixed costs are incurred regardless of the level of production. Two types of fixed costs exist: those that occur only once at the start-up of a business and those that regularly recur. Variable costs depend on the level of production at a plant and fall to zero if the plant ceases operations entirely. These three categories of costs are described below:

(1) Fixed start-up costs: the costs associated with the decision to open a dry cleaning plant,

(2) Fixed recurring costs: the costs associated with the decision to operate the dry cleaning plant, and

(3) Variable costs: the costs associated with the decision to operate the dry cleaning plant at a given level of output.

The first category of costs includes most, if not all, capital costs as well as long-term materials contracts and capacity investments. Table 2-10 shows the capital costs of new dry-to-dry machines. In addition, some administrative fees and initial building overhead costs, such as remodeling or down payment, are included in this category of costs. These expenses are the fixed costs that are incurred regardless of the level of production or whether the firm operates at all. Total estimated start-up costs typically range from $95 to $120 thousand (Faig, 1991).

Table 2-11 displays information on the second and third categories of costs for commercial dry cleaning facilities by output level. On average, total wages and salaries account for the largest portion of dry cleaning costs followed by rent/building overhead expenses or total supply cost. The majority of costs incurred by a dry cleaning plant are variable such as solvent, labor, and energy costs. Table 2-12 provides unit price information for the major inputs that contribute to the variable costs of operating a dry cleaning facility.

TABLE 2-10. CAPITAL COSTS OF NEW DRY-TO-DRY MACHINES ($1989)

Machine Capacity (kg/load)	Capital Cost ($)
11.3	26,046
13.6	27,820
15.9	29,594
20.4	42,171
22.7	44,040
27.2	47,040
45.4	65,255
63.5	104,000
113.4	157,000

Source: Radian, 1990a.

Dry cleaning plants have relatively small capital equipment costs, although these vary between the sectors. In addition, the buildings used by many plants are rented or easily transferable to other uses. As a result, the relatively high variable cost to fixed cost ratio at most dry cleaning facilities promotes a dynamic industry structure in which the less efficient plants quickly terminate operations if losses become excessive.

The decision to open a new plant must be evaluated based on the costs included in all three categories above. However, for existing facilities, costs in category 1 are sunk and do not affect the owner's decision to continue operating. Production cost for existing and new facilities are discussed below.

TABLE 2-11. AVERAGE ANNUAL OPERATING COSTS FOR COMMERCIAL DRY CLEANING PLANTS

	Annual Output (kg/yr)[a]				
Cost Category	2,378	5,436	8,985	12,580	40,775
Fixed Recurring Costs					
Wages and Salaries[b]	3,542	8,078	13,383	18,736	81,727
Rent or Building Overhead	1,316	3,002	4,973	6,962	20,955
Depreciation	1,272	2,901	4,805	6,728	11,922
Interest and Bank Charges	779	1,776	2,942	4,119	3,163
Insurance	576	1,315	2,178	3,049	7,786
Variable Costs					
Wages and Salaries	3,024	6,898	11,428	16,000	58,722
Total Supply Cost	1,541	3,515	5,824	8,154	23,175
Outside Work	1,437	3,277	5,429	7,600	15,876
Payroll taxes	541	1,234	2,044	2,862	12,470
Advertising	435	991	1,642	2,299	10,949
Utility—Fuel	360	821	1,361	1,905	6,661
Repairs and Maintenance	312	712	1,180	1,651	6,813
Utility—Electricity	268	611	1,012	1,417	8,394
Office Expense	259	591	979	1,370	3,498
Administrative Expense	241	550	911	1,276	4,015
Utility—Water and Sewage	117	267	442	619	3,224
Claims	92	210	340	488	1,247
Miscellaneous	908	2,071	3,431	4,804	10,707
Total Costs	17,019	38,820	64,313	90,038	291,392

[a]Based on the average annual receipts for five income categories reported in Table 2-2.

[b]Includes owner's wages.

Source: International Fabricare Institute, 1989; Fisher, 1990b.

TABLE 2-12. AVERAGE INPUT PRICES FOR PCE DRY CLEANING FACILITIES ($1989)

Input	Price
Material	
Perchloroethylene	$0.683/kg
Energy	
Electricity	$0.0710/kWh
Steam	$6.13/1000 lb
Labor	
Operating labor	$5.94/hr
Maintenance labor	$6.53/hr

Source: Radian, 1990d.

2.4.1 Costs of Production for Existing Facilities

The short-run supply curve of an existing dry cleaning facility is the portion of its marginal cost curve that lies above the minimum point of its average variable cost curve. In other words, facilities will continue to supply dry cleaning services in the short run as long as they can cover their variable costs of production. The market supply curve is the horizontal aggregation of the supply curves for all facilities in the market. This aggregation is characterized in the step supply function (see Figure 2-3) where the producer with the highest marginal cost in the market sets the market price of dry cleaning services.

Lower cost producers are able to cover some or all of their fixed costs because the market price is above their average variable cost. Differences in the production costs across producers are attributed to differences in management practices as well as differences in the productivity of capital equipment. Assuming that the productivity of dry cleaning equipment has been increasing over time, owners of new equipment would tend to have lower marginal costs than owners of older equipment, ceterus paribus.

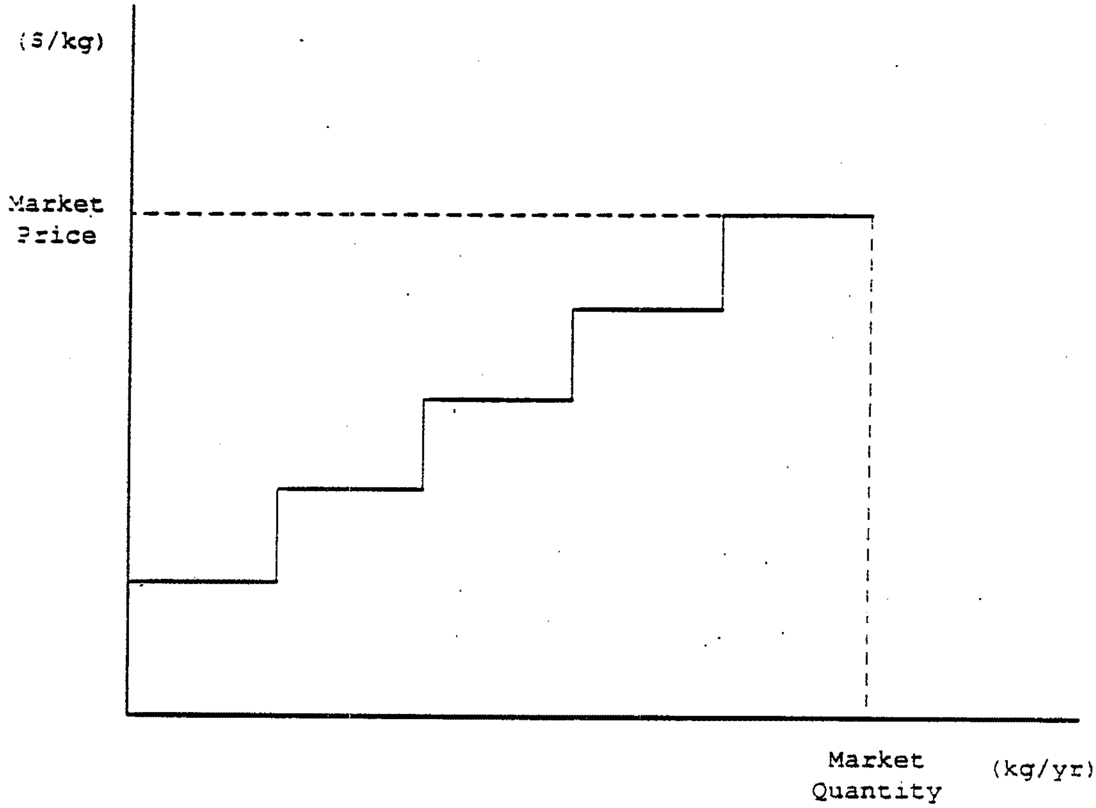

Figure 2-3. Market Supply Curve for Existing Facilities

An increase in the price of a variable input changes the facility's average variable cost and its marginal cost. Changes in the marginal cost of producing dry cleaning services would cause a shift in the supply of dry cleaning services resulting in price and output adjustments at least in the short run.

2.4.2 Costs of Production for New Facilities

An entrepreneur contemplating construction of a new dry cleaning facility won't invest unless he/she anticipates covering total costs. By definition, total cost for a new facility includes fixed start-up costs including a normal return, fixed recurring costs, and variable costs. If the average total cost of opening a new dry cleaning plant is above the market price, no new entry will occur. Conversely, if the average total cost is below the market price, new entry will occur (see Figure 2-4). Therefore, any

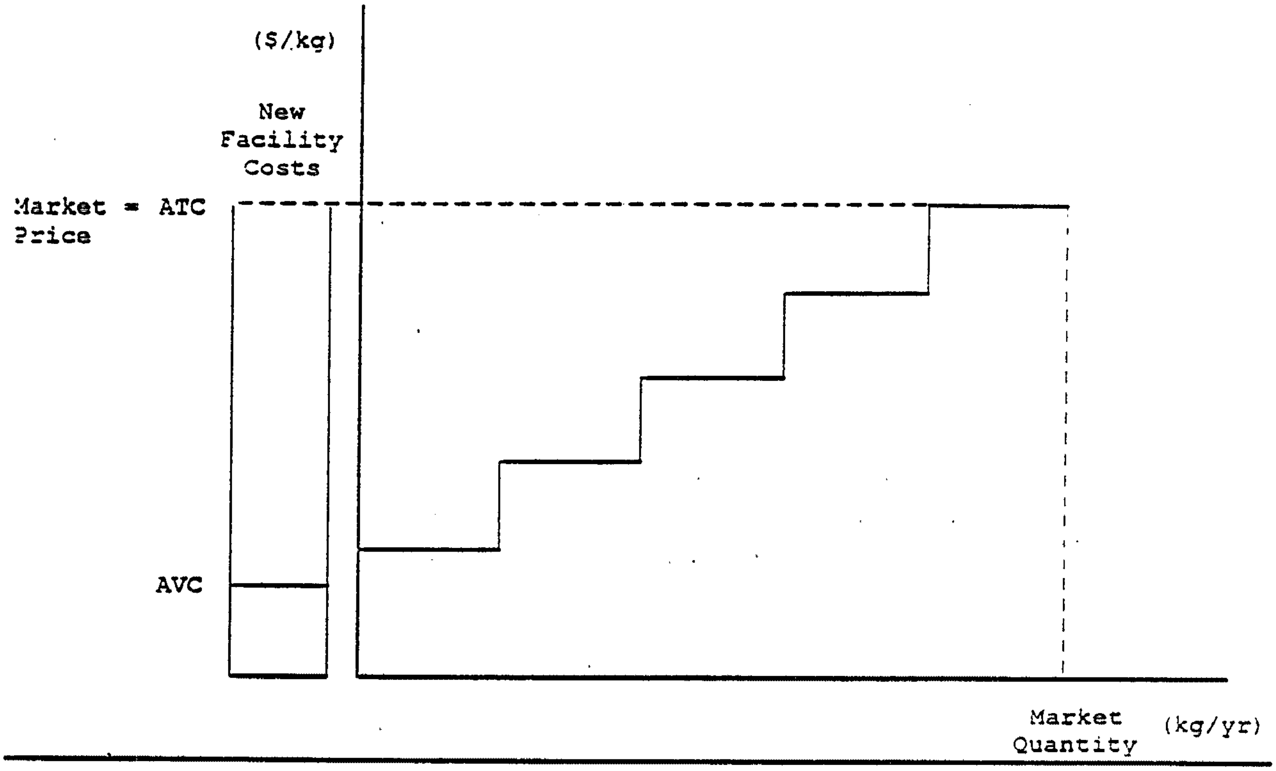

Figure 2-4. New Facility Costs Compared to Market Supply Curve for Existing Facilities

increase in the marginal costs of existing producers not affecting new suppliers would have the effect of encouraging new entry into the market. The entry of a new facility into the market displaces the marginal existing supplier. As the marginal suppliers are displaced in the market, price falls. This process continues until price equals the average total cost of building a new facility. Long-run price and output equilibrium, therefore, depends on the average total cost of building a new facility. Once a new facility is constructed, the fixed costs become sunk costs and only the variable costs are relevant to the decision to continue operating the facility. The facility continues to supply dry cleaning services as long as price exceeds average variable cost.

2.5 MODEL FACILITY PROFILE

The abundance of dry cleaning establishments precludes an approach that investigates the impacts of candidate regulatory alternatives on a facility-specific level. Ignoring the resource costs of collecting data for such a large sample, computational time alone diminishes the feasibility of a facility-specific approach. Consequently, a model plant approach is used in which fifteen model plants represent the characteristics of average PCE facilities in each sector. Table 2-13 presents operating parameters of the model plants by industry sector, machine size, and process. In addition, the distribution of PCE facilities represented by each model plant is reported for five output levels. These output levels correspond to ranges of annual receipts shown in Table 2-13.

The model plants were chosen to represent the variability in machine size and technology that is present among existing facilities in the industry. The coin-operated sector has basically only one machine size and design. However, two model facilities in this sector are differentiated by the base price charged for dry cleaning services and the type of service supplied (self-service or coin-operated). Ten model plants for the commercial sector and three model plants were selected for the industrial sector. Most of the contemporary dry cleaning facilities are purchasing dry-to-dry machines to save on solvent costs, to comply with a recently promulgated worker exposure regulation, and to reduce the environmental impact of PCE emissions. Nevertheless, some facilities continue to operate with transfer machines, and that portion of the industry is represented through appropriate model plants.

TABLE 2-13. MODEL PLANT DESCRIPTION AND THE DISTRIBUTION OF PCE FACILITIES BY INDUSTRY SECTOR AND INCOME LEVEL

Industry Sector and Model Plant Number	Machine Type	Machine Capacity (kg/load)	Operating Days Per Year	Total Number Facilities Per Model Plant Category	Number Facilities in Each Model Plant Category by Income Level ($000/yr)				
					0-25	25-50	50-75	75-100	>100[d]
Coin-Operated									
1 (self-service)	dry-to-dry	3.6	312	213	42	117	38	16	0
2 (plant-operated)	dry-to-dry	3.6	250	2,831	481	1,334	437	153	426
Total				3,044	523	1,451	475	169	426
Commercial									
3	dry-to-dry	11.3	250	2,639	1,355	527	430	155	128
4	dry-to-dry	13.6	250	1,766	901	440	274	0	76
5	dry-to-dry	15.9	250	9,761	1,838	1,336	888	532	2,584
6	transfer	15.9	250	7,665	2,748	1,403	628	603	1,142
7	dry-to-dry	20.4	250	2,753	0	353	296	645	730
8	dry-to-dry	22.7	250	2,317	0	183	91	284	880
9	transfer	22.7	250	1,918	0	28	25	219	823
10	dry-to-dry	27.2	250	91	0	0	0	57	34
11	dry-to-dry	45.4	250	1,605	0	0	0	137	1,468
12	transfer	45.4	250	726	0	0	0	0	726
Total				24,947	6,822	4,270	2,632	2,632	8,591

CONTINUED

TABLE 2-13. MODEL PLANT DESCRIPTION AND THE DISTRIBUTION OF PCE FACILITIES BY INDUSTRY SECTOR AND INCOME LEVEL (CONTINUED)

Industry Sector and Model Plant Number	Machine Type	Machine Capacity (kg/load)	Operating Days Per Year	Total Number Facilities Per Model Plant Category	Number Facilities in Each Model Plant Category by Income Level ($000/yr)				
					0-25	25-50	50-75	75-100	>100[a]
Industrial									
13	dry-to-dry	63.5	250	18	0	0	0	0	18
14	dry-to-dry	113.4	250	28	0	0	0	0	28
15	transfer	113.4	250	84	0	0	0	0	84
Total				130	0	0	0	0	130

[a]Facilities in the commercial sector with over $100 thousand in annual income may represent more than one machine. On average, there are 1.75 machines per facility in this category in the commercial sector.

Source: Radian 1991c; Radian 1990c.

SECTION 3

DEMAND FOR DRY CLEANING SERVICES

Two types of demand exist for dry cleaning services: household demand and industrial demand. Household demand is characterized by individual consumers purchasing dry cleaning services provided by commercial and coin-operated facilities. Industrial demand is characterized by firms purchasing dry cleaning services to clean employee uniforms in production and service establishments. Typically, employers rent these uniforms from an industrial cleaner who provides regular cleaning and delivery services. The subsequent sections discuss household demand and industrial demand in detail.

3.1 HOUSEHOLD DEMAND

As consuming units, households demand clean, pressed clothes. Because some garments require dry cleaning for proper care, households rely on dry cleaning services provided by others to procure clean, pressed clothes. Two types of dry cleaning services--commercial and coin-operated--are available to households. Commercial facilities and coin-operated (plant-operated) provide a complete service: garments are cleaned, pressed, and packaged for the consumer. At self-service coin-operated facilities, consumers pay for using dry cleaning machines, but they must clean and press their own clothes. Despite some similarities in the influences of demand for these services, these two sectors have experienced different growth patterns.

The subsections below discuss different facets of household demand. The first two subsections explore consumption patterns and characteristics of the consumers of dry cleaning services. The next subsection discusses the theory of household production in the context of dry cleaned clothing. How consumers value their time and their choice between coin-operated and commercial facilities is presented in the fourth subsection. The final subsection briefly examines consumer sensitivity to changes in the price of dry cleaning services.

3.1.1 Consumption and Trends

Household consumption of commercial dry cleaning services can be measured in terms of the total weight of clothes dry cleaned or in terms of total expenditures on dry cleaning services. Figure 3-1 shows that overall consumption, measured by the total weight of clothing cleaned, increased by more than 25 percent from 1980 to 1988. However, on a per-household basis, demand for dry cleaning services increased only 11 percent during this period. Consumption per household reached its peak in 1986, when the average household consumed almost 7 kilograms per year. This pattern is depicted in Figure 3-2.

Table 3-1 shows household consumption in terms of expenditures. These data are calculated from the Consumer Expenditure Surveys (U.S. Department of Labor, 1991a). The survey compiles average annual household expenditures for a broad category called "Other Apparel Products and Services."[1] This category encompasses a wide range of goods and services, including material for making clothes, shoe repair, clothing alterations and repairs, sewing supplies, clothing rental, clothing storage, coin-operated laundry and dry cleaning, commercial laundry and dry cleaning, watches and jewelry, and watch and jewelry repair.

Expenditures on commercial laundry and dry cleaning services were estimated in the following manner. Detailed information on the relative weight of each category item (listed above) used to compile the Consumer Price Index was available for the period 1982-1984 (Manson and Butler, 1987). Based on those relative weights, expenditures on laundry and dry cleaning services (excluding coin-operated) made up about 25 percent of the category for those years. The expenditures for each category item listed above were available for 1989. Approximately 24 percent of the category expenditures were spent on laundry and dry cleaning (excluding coin-operated). The expenditures reported in Table 3-1 represent 25 percent of the "Other Apparel Products and Services" category.[2] Because the portion of the category attributed to laundry and dry

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[1]The expenditures on apparel items come from the interview portion of the Survey. Because the reported expenditures are based on the consumer's memory, these data may not accurately reflect receipts at commercial dry cleaning establishments.

[2]For the years 1980-1983, only data on urban consumers were available. The expenditures estimated in Table 9-15 were adjusted to reflect all consumers in the following manner. In 1989, urban consumers spent three times what rural consumers did on commercial dry cleaning services; that relationship was assumed to hold for the years 1980-1983. In addition, rural households were assumed to comprise 16 percent of all households, which is approximately the portion that they comprised for the years 1984-1986. The reported estimates are a weighted average of urban consumer spending and rural consumer spending.

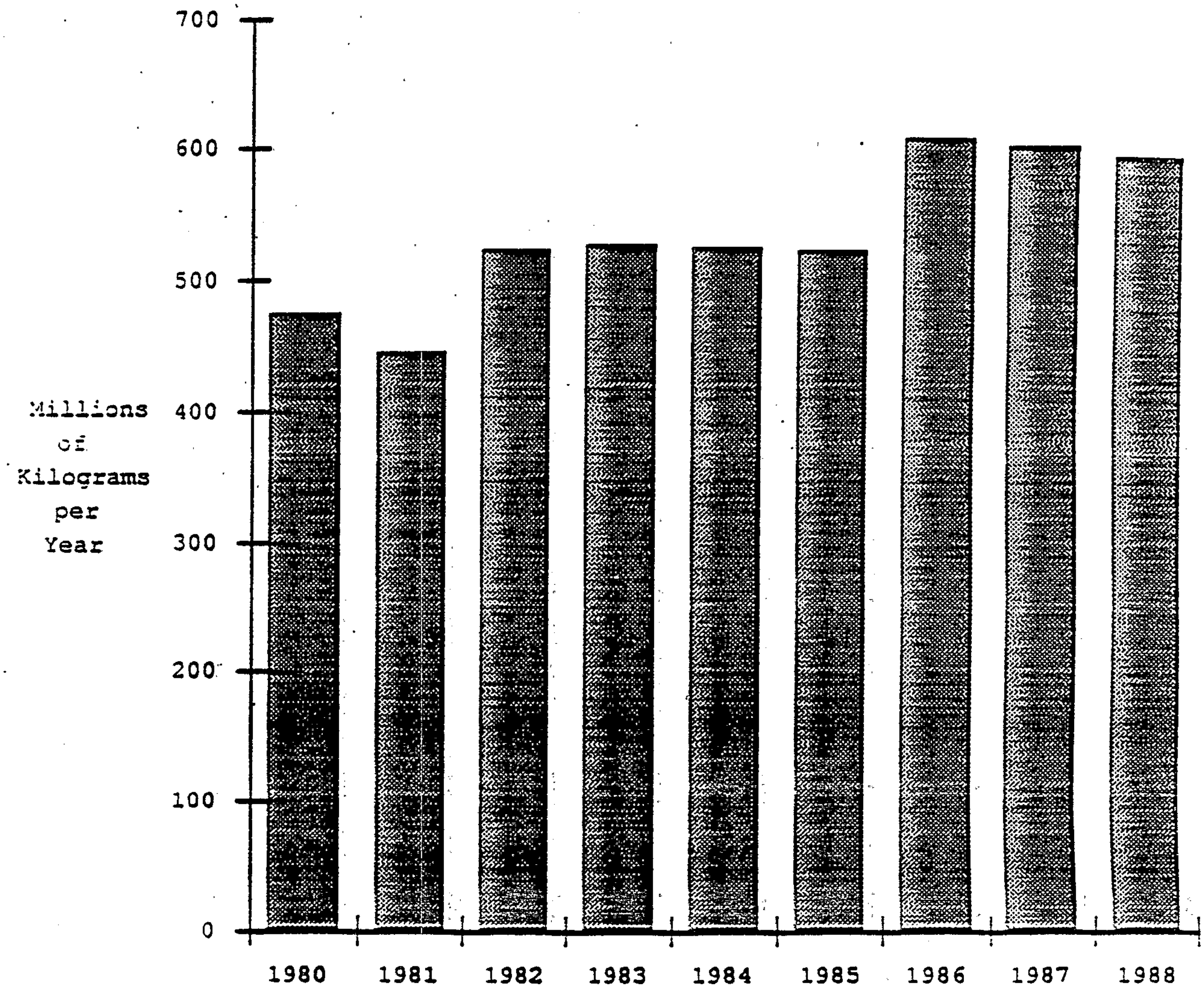


Figure 3-1. Total Annual Household Consumption of Commercial Dry Cleaning Services (1980-1988)

Source: Table 2-8

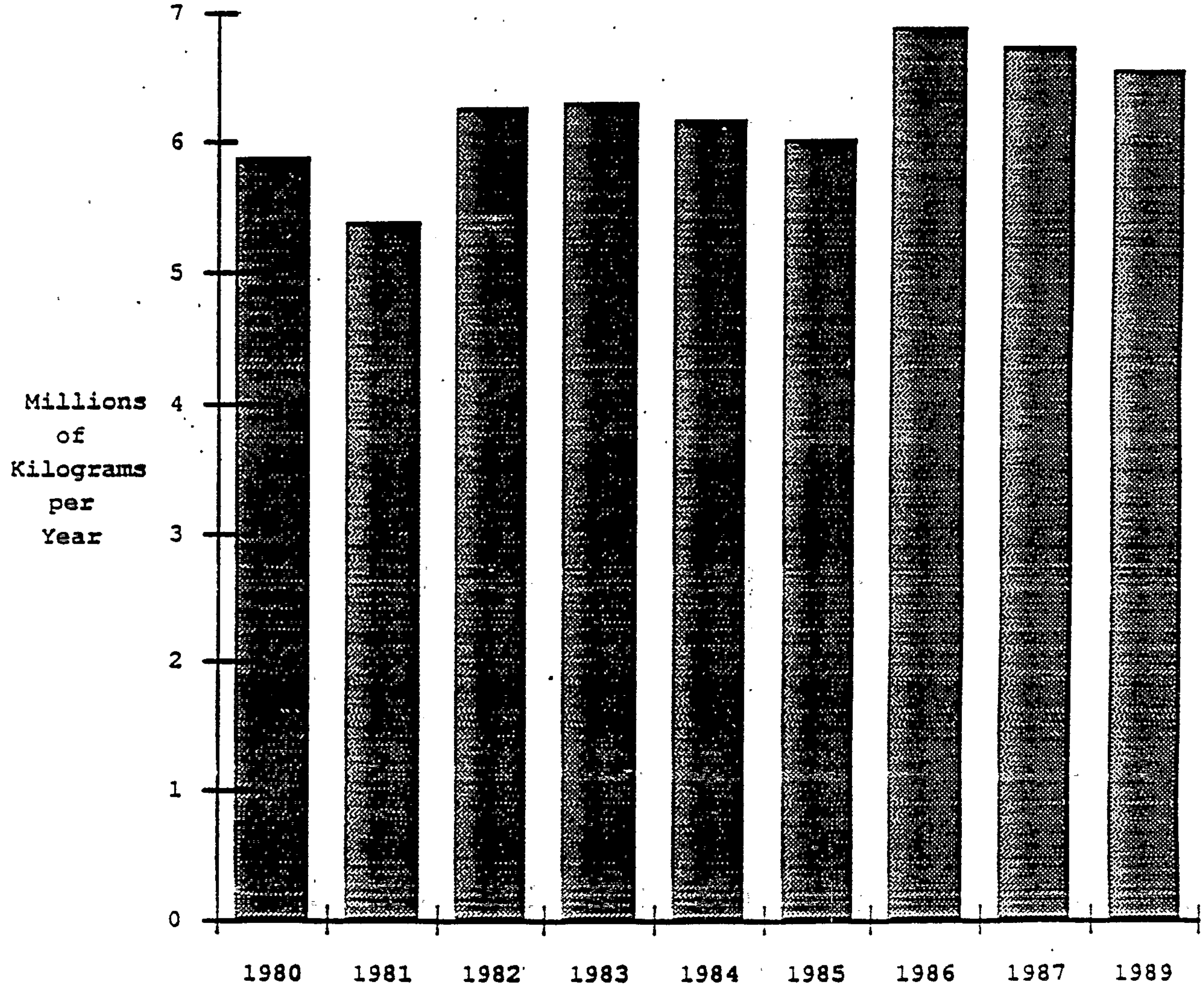


Figure 3-2 Annual Consumption of Commercial Dry Cleaning Services per Household (1980-1988)

[a]Computed by dividing total dry cleaning output (Table 2-8) by the total number of households in the U.S. reported in Statistical Abstract of the United States (U.S. Department of Commerce, 1991d); U.S. Department of Commerce, 1991.

TABLE 3-1. HOUSEHOLD EXPENDITURES ON COMMERCIAL LAUNDRY AND DRY CLEANING SERVICES 1980-1989 ($1989)

Year	Average Annual Household Expenditures ($/Household/Year)[a]	Increase (%)	Expenditures as a Share of Income (%)[b]	Total Annual Household Expenditures ($$10^6$/yr)[c]	Increase (%)
1980	62.18	—	0.15	5,022	—
1981	57.58	-7.4	0.14	4,757	-5.3
1982	55.96	-2.8	0.14	4,675	-1.7
1983	58.95	5.3	0.14	4,947	5.8
1984	62.95	6.8	0.14	5,377	8.7
1985	67.70	7.5	0.15	5,876	9.3
1986	66.75	-1.4	0.15	5,905	0.5
1987	68.49	2.6	0.15	6,129	3.8
1988	67.35	-1.7	0.14	6,132	0.1
1989	66.50	-1.3	0.14	6,173	0.7

[a]Represents 25 percent of "Other Apparel Products and Services." Original data for 1980-1983 excluded rural consumers and were adjusted to include rural consumers. Converted to 1989 dollars using all items CPI.
[b]Based on before tax income. Income calculated by multiplying national personal income by the number of households.
[c]Average household expenditures multiplied by number of households.

Sources: 1980-1989 Consumer Expenditure Survey, U.S. (Department of Labor, 1991a); Economic Report of the President, 1990; Statistical Abstract of the United States, (U.S. Department of Commerce, 1990d); U.S. Department of Commerce, 1991).

cleaning expenditures remained fairly constant over time, the data characterize commercial laundry and dry cleaning expenditures fairly well. Approximately 85 percent of a typical consumer's commercial cleaning bill is dry cleaning, as opposed to laundry (U.S. Department of Commerce, 1991).

Notice that, in 1980, households spent $62 a year on average; in 1989 that figure had increased to $67, an 8 percent increase. Aggregating across the United States yields total expenditures of more than $5.0 billion in 1980 and $6.2 billion in 1989.

Two main factors affecting the growth of dry cleaning consumption are textile and lifestyle trends. During the 1970's, fashion trends demanded easy-care fabrics. Because these fabrics, normally synthetic or a synthetic blend, do not necessarily require dry cleaning, consumption of dry cleaning services decreased. Returning to more natural fibers and synthetic materials that require dry cleaning for proper care led to increased consumption in the 1980's (Fischer, 1987).

The demand for commercial dry cleaning services is also influenced by general economic conditions as well as fashion trends. Prevailing economic conditions influence the purchase of more expensive garments, which often require dry cleaning for proper care. Another factor that increased household demand for cleaning services is the increase in the number of women in the work force. The impact on commercial cleaning comes from both the increased opportunity cost of a working woman's time and the increase in the number of women working outside the home. Table 3-2 shows the change in the number of women in the work force and the median income for women for the period 1980-1989.

Consumption at coin-operated facilities is also strongly affected by general economic conditions, though sometimes for different reasons than commercial dry cleaning consumption. Historically, the cleaning volume at coin-operated facilities plants has fluctuated with the economy.

Data on coin-operated consumption are sparse. However, the Census of Services Industries does publish receipts for coin-operated laundry and dry cleaning facilities. Caution must be exercised when applying these data to the dry cleaning industry because the receipts include laundry receipts. In 1982, coin-operated laundry and dry cleaning establishments (with payroll) across the United States took in $1,501 million in constant (1989) dollars compared to $1,821 million in 1987 (U.S. Department of Commerce, 1990c). This increase amounts to 21 percent. Receipts also increased in per-capita terms. Per-capita expenditures expressed in constant dollars rose from $5.02 in 1982 to $6.83 in 1987.

TABLE 3-2. NUMBER AND MEDIAN INCOME OF WOMEN IN THE WORK FORCE 1980-1989 ($1989)

Year	Number of Women[a] (000)	Change (%)	Median Income[b] ($1989)	Change (%)
1980	42,117	—	17,443	—
1981	43,000	2.10	16,994	-2.57
1982	43,256	0.60	17,558	3.32
1983	44,047	1.83	18,038	2.73
1984	45,915	4.24	18,406	2.04
1985	47,259	2.93	18,730	1.76
1986	48,706	3.06	19,057	1.75
1987	50,334	3.34	19,173	0.61
1988	51,696	2.71	19,439	1.39
1989	53,027	2.57	N/A	—

[a]Includes working women over the age of 16.
[b]Data includes women over the age of 15 with full-time employment. Converted to 1989 dollars using the all items CPI.

Source: Economic Report of the President, 1990.

3.1.2 Characterization of Consumers

Although every individual probably owns at least a few garments that require dry cleaning for proper care, individuals who use dry cleaning services on a regular basis have identifiable characteristics. People's need for dry cleaning services depends on the clothing they own and their occupation, which may dictate their clothing choices. White collar workers are more likely to own clothing that requires dry cleaning for proper care. Similarly, individuals in professional positions would utilize dry cleaning services more. By extension, individuals with higher incomes would be expected to use dry cleaning services more often.

Consumer Expenditure Survey data for 1989 support these contentions. Tables 3-3, 3-4, and 3-5 present data for two types of expenditures: (1) expenditures on laundry and dry cleaning, excluding coin-operated and (2) expenditures on coin-operated laundry and dry cleaning. These data are compiled by income levels (see Table 3-3), occupation (see Table 3-4), and location (see Table 3-5). As indicated above, the expenditures for the commercial sector are predominantly for dry cleaning services. This assumption does not necessarily hold for the coin-operated sector, where the majority of the expenditures are for laundry expenses. Caution must be exercised when interpreting the coin-operated data.

As expected, expenditures on commercial dry cleaning increase with income (see Table 3-3). An individual earning more than $50,000 a year spends more than four times on dry cleaning than an individual earning less than $30,000. These higher expenditures are induced by two factors. The first is the need to dry clean most professional career clothing. The second is the propensity for individuals with higher incomes to own luxury clothing (e.g., leather, suede), which requires dry cleaning for proper care. Also, as shown in Table 3-3, coin-operated expenditures decline with income, although laundry expenditures cannot be separated from the dry cleaning expenditures.

Figure 3-3 depicts this switch from coin-operated expenditures to commercial expenditures as income rises. A point of further interest is that expenditures on commercial cleaning are a relatively stable share of income across all income levels. This stability suggests that any one income class would not be more affected if prices increase.

Table 3-4 shows expenditures on commercial and coin-operated cleaning by occupation classification. Individuals whose occupations fall in the manager/professional category spend almost 83 percent more than any other job category on commercial cleaning services. Individuals with technical, sales, or clerical positions spend more than $75 a year on commercial cleaning, which is 135 percent more than any of the remaining categories.

TABLE 3-3. HOUSEHOLD EXPENDITURES ON COMMERCIAL AND COIN-OPERATED DRY CLEANING AND LAUNDRY SERVICES BY INCOME CATEGORY ($1989)

	Commercial Cleaning Services[a]		Coin-Operated Cleaning Services[a]	
Income Category[b] ($000/yr)	Average Annual Expenditure ($/Household/yr)	Expenditures as a Share of Income[b] (%)	Average Annual Expenditure ($/Household/yr)	Expenditures as a Share of Income[b] (%)
5-10	17.40	0.23	45.90	0.61
10-15	18.57	0.15	42.14	0.34
15-20	30.57	0.18	41.92	0.24
20-30	42.06	0.17	43.76	0.18
30-40	62.13	0.18	35.06	0.10
40-50	90.75	0.20	23.95	0.05
over 50	175.93	0.22	15.81	0.02

[a]Estimates of annual household expenditures are based only on those households that purchase these services and do not take into account those households that do not purchase each type of cleaning services. These estimates include both laundry and dry cleaning expenses. Expenditures at commercial establishments comprise mainly dry cleaning expenditures; only a small portion of expenditures at coin-operated establishments constitute dry cleaning expenditures.

[b]Based on before-tax income.

Source: 1980-1989 Consumer Expenditure Survey (U.S. Department of Labor, 1991a).

Finally, household cleaning expenditures differ greatly depending on the geographic location (see Table 3-5). Urban consumers spend three times as much on commercial cleaning than do their rural counterparts. This difference in expenditures probably reflects occupation choices.

The Consumer Expenditure Survey data reveal that the typical consumer of commercial dry cleaning services is a manager or professional, earns more than

TABLE 3-4. HOUSEHOLD EXPENDITURES ON COMMERCIAL AND COIN-OPERATED DRY CLEANING AND LAUNDRY SERVICES BY OCCUPATION CATEGORY

	Commercial Cleaning Services[a]		Coin-Operated Cleaning Services[a]	
Occupation Category	Average Annual Expenditure ($/Household/yr)	Expenditures as a Share of Income[b] (%)	Average Annual Expenditure ($/Household/yr)	Expenditures as a Share of Income[b] (%)
Manager/ Professional	138.28	0.28	27.14	0.06
Technical/ Sales/ Clerical	75.68	0.23	46.79	0.14
Service Workers	31.26	0.15	54.41	0.27
Construction/ Mechanics	32.25	0.10	37.61	0.12
Operators/ Labor	31.05	0.11	43.24	0.15

[a]Estimates of annual household expenditures are based only on those households that purchase these services and do not take into account those households that do not purchase each type of cleaning services. These estimates include both laundry and dry cleaning expenses. Expenditures at commercial establishments comprise mainly dry cleaning expenditures; only a small portion of expenditures at coin-operated establishments constitute dry cleaning expenditures.
[b]Based on before-tax income.

Source: 1980-1989 Consumer Expenditure Survey (U.S. Department of Labor, 1991a).

$20,000 a year, and lives in an urban area. Making generalizations about the coin-operated expenditure data is more difficult. But conversations with coin-operated industry experts provide a picture of the typical consumer of coin-operated dry cleaning. The typical patron is cost-conscious, probably in the lower income brackets but may be in the lower middle class as well. This patron is more likely to live in a rural location where commercial facilities are not available (Torp, 1991). The data do not refute this description.

3.1.3 Household Demand Function

Like any demand function, household demand for dry cleaning services is derived from utility maximization. Utility comes from commodities, not directly from goods and services. Households combine goods and services with time as inputs into a process that generates commodities. Thus, time spent on

TABLE 3-5. HOUSEHOLD EXPENDITURES ON COMMERCIAL AND COIN-OPERATED DRY CLEANING AND LAUNDRY SERVICES BY LOCATION CATEGORY

	Commercial Cleaning Services[a]		Coin-Operated Cleaning Services[a]	
Location Category[b]	Average Annual Expenditure ($/Household/yr)	Expenditures as a Share of Income[c] (%)	Average Annual Expenditure ($/Household/yr)	Expenditures as a Share of Income[c] (%)
Urban	72.9	0.22	37.24	0.11
Rural	23.5	0.10	16.90	0.07

[a]Estimates of annual household expenditures are based only on those households that purchase these services and do not take into account those households that do not purchase each type of cleaning services. These estimates include both laundry and dry cleaning expenses. Expenditures at commercial establishments comprise mainly dry cleaning expenditures; only a small portion of expenditures at coin-operated establishments constitute dry cleaning expenditures.

[b]An urban area is defined as an area within a Standard Metropolitan Statistical Area (SMSA) or one with a population of more than 2,500 persons. A rural area is an area outside of an SMSA and with a population of less than 2,500 persons

[c]Based on before-tax income.

Source: 1980-1989 Consumer Expenditure Survey (U.S. Department of Labor, 1991a).

nonwork activities is crucial to producing commodities (Becker, 1965). Commodities form the basis of the household utility function. That function is maximized subject to a budget constraint and a time constraint, both of which limit the goods, services, and commodities available to the household.

When choosing the combination of goods, services, and time that will be used to produce any given commodity, the household makes its decision based on the utility-maximizing option. Households have the option of substituting time for goods or services in the event that such substitution yields more utility. For example, a meal could be provided by combining groceries and time to produce a home-cooked meal or by eating out at a restaurant. How the household makes these choices depends on its value of time.

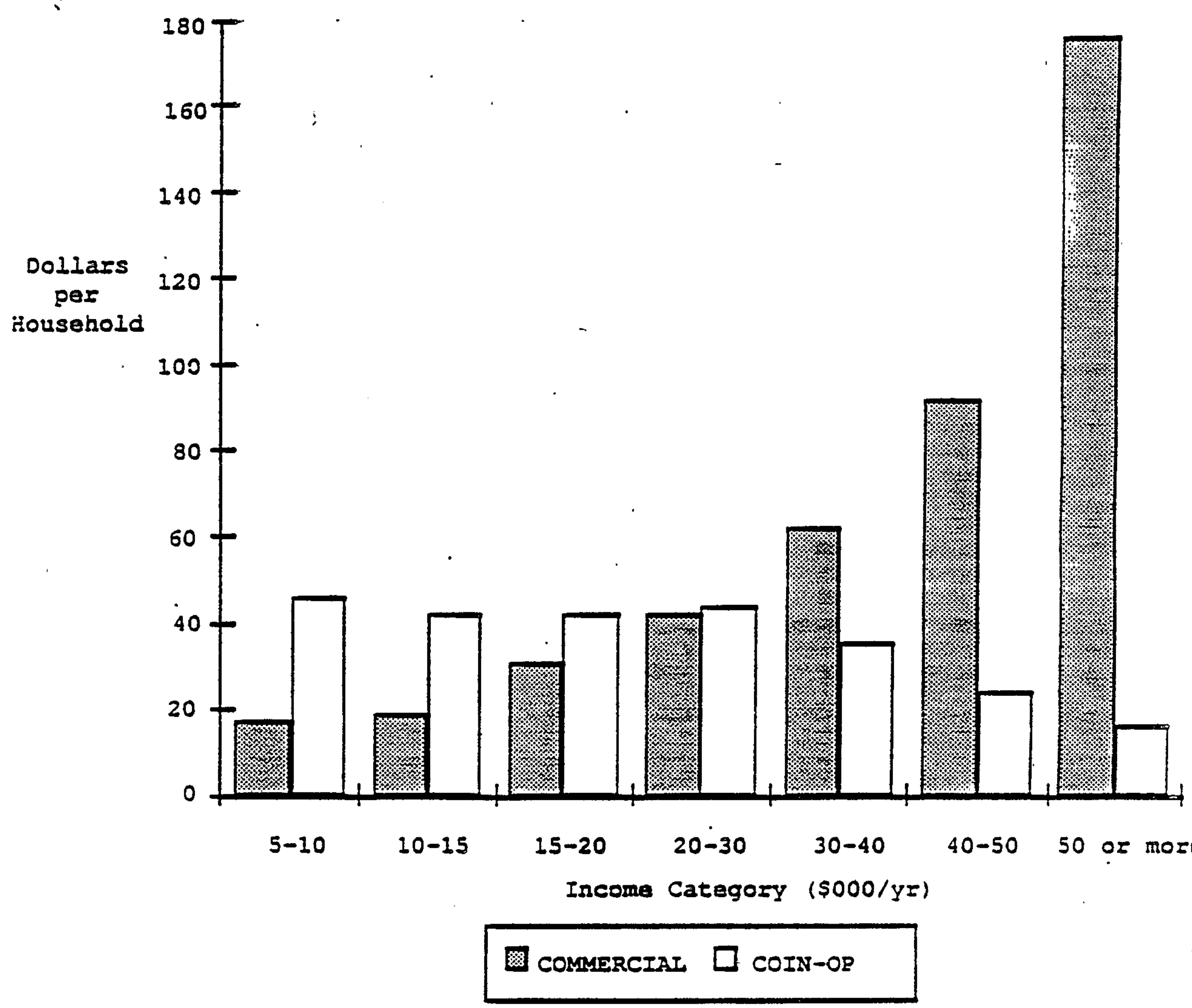


Figure 3-3. Average Annual Expenditures on Dry Cleaning and Laundry Services by Income Class ($1989)

Source: 1980-1989 Consumer Expenditure Survey, (U.S. Department of Labor, 1991a).

A household's production of clean, pressed clothing can be analyzed in this framework. If the garment requires dry cleaning, the household, in theory, has two choices: self-service dry cleaning (offered by self-service, coin-operated facilities) or employee-assisted dry cleaning (offered by commercial or coin-operated [plant-operated] facilities). In the balance of this section, employee-assisted dry cleaning will be referred to as commercial dry cleaning and self-service dry cleaning will be referred to as coin-operated. In the coin-operated production process, consumers pay for using the machines but clean and press the clothing themselves. In the commercial cleaning process, consumers use their time to deliver and pick-up the garments and pay for others to clean and press them. Although the market price of the coin-operated method is lower, it requires more of consumers' time. Assuming that consumer utility does not differ between clothes cleaned by household production and clothes cleaned by a commercial cleaner, the household's decision will depend on the opportunity cost of time.

A household production model similar to one developed by Gronau (1977) is used to show how a household makes the decision to use commercial or coin-operated dry cleaning. The household seeks to maximize the amount of cleaned, pressed clothes, commodity Z, which is produced by combining dry cleaning services, either commercial or coin-operated, (X) and consumption time (L).

$$Z = Z\ (X,\ L) \tag{3.1}$$

X includes both the value of market goods or commercially cleaned clothes (X_m) and the value of home goods or clean clothes produced by the consumer using machinery and time (X_h).

$$X = X_m + X_h \tag{3.2}$$

Home goods are produced by work at home: H represents the number of hours per day spent producing clean clothing at home.

$$X_h = f(H) \tag{3.3}$$

Utility is maximized subject to two constraints. The first is a budget constraint where W is a wage rate, N is time spent on market work, and V is other income.

$$X_m = WN + V \tag{3.4}$$

The second constraint is a time constraint (T).

$$T = L + H + N \tag{3.5}$$

Equations (3.1), (3.2), and (3.3) are then combined and maximized subject to equations (3.4) and (3.5).

$$G = Z\{[X_m + f(H)], L\} + \lambda(WN + V - X_m) + \delta(T - L - H - N) \tag{3.6}$$

Z is maximized when the marginal rate of substitution between time and goods is equal to the marginal product of home production and equal to the wage rate:

$$(dZ/dL) \;/\; (dZ/dX) = f\,' = W \tag{3.7}$$

In addition, the wage will equal the opportunity cost of time (W*) and the ratio of the marginal utilities of time and income.

$$W = W^* = \delta \;/\; \lambda \tag{3.8}$$

This model confirms earlier observations about the relationship between income and dry cleaning expenditures. Because the opportunity cost of time is higher for those with higher incomes, commercial expenditures should rise and coin-operated expenditures should fall as income rises.

3.1.4 The Value of Time and the Full-Cost Model

The relationship between the value of time and income or wages has been well established in literature. Becker (1965) demonstrated that time allocation is based on earnings. An increase in earnings results in a shift away from time-intensive consumption to goods-intensive consumption. A later study by Kooreman and Kapteyn (1987) confirmed that the amount of household work performed by a member is a function of wage rate. In a study on queuing, Deacon and Sonstelie (1985) estimated the value of time to be roughly equivalent to the after-tax wage.

Data are not available to measure the value of time to an individual who chooses to use coin-operated dry cleaning facilities compared to an individual who utilizes a commercial cleaner. However, using the Consumer Expenditure Survey data gives an estimation of the relationship between dry cleaning expenditures and income.

Data at the household level were available and included expenditures on commercial and coin-operated dry cleaning, income, and other demographic information such as education, type of employment, family size, and an urban/rural designation. Two ordinary least squares (OLS) equations were estimated--one for commercial dry cleaning expenditures and one for coin-operated dry cleaning expenditures. The independent variables included income and the dummy variables for the remaining demographic data.[3] The coefficients for income are very significant and have the expected signs in both models (positive for commercial and negative for coin-operated). Many of the other demographic variables behave as expected. Unfortunately, the equations do not explain all of the influences on dry cleaning expenditures very well. But the equations do demonstrate the relationship between income and expenditures on commercial cleaning. The results are presented in Table 3-6. Because income plays such an influential role in consumers' choice of using commercial or coin-operated dry cleaning facilities, consumers are likely to switch from using a coin-operated facility to a commercial facility at a critical wage or value of time. Above a certain wage, consumers are likely to value their time enough to make the time-intensive coin-operated approach too costly when the value of their time is included in the calculation. A full-cost model for dry cleaning was developed that identifies the critical wage at which the switch from coin-operated to full service occurs. The full cost of a commodity is the sum of the prices of the goods and services consumed and of the time used in producing these commodities. Direct costs are the prices of the goods and

[3]The data set consists of four quarters of household data. Dummy variables for the quarters were also included in the equation to account for differences in the quarterly responses.

TABLE 3-6. REGRESSION ANALYSIS[a]

Variables	Dependent Variable: Commercial Expenditures	Dependent Variable: Coin-Operated Expenditures
C	-2.55 (-2.27)	4.79 (6.67)[a]
Income	0.0005 (41.77)[b]	-0.0001 (-13.49)[b]
Education Dummy (1 if college graduate)	11.03 (14.86)[b]	-2.25 (-4.75)[b]
White Collar Dummy (1 if manager or professional)	5.32 (8.50)[b]	2.26 (5.65)[b]
Family Size	-1.48 (-7.69)[b]	0.74 (6.01)[b]
Urban Dummy	4.97 (5.42)[b]	5.40 (9.22)[b]
2nd Quarter Dummy	-1.49 (-1.88)	-0.05 (-1.11)
3rd Quarter Dummy	-2.21 (-2.78)[b]	-0.78 (-1.55)
4th Quarter Dummy	-2.05 (-2.61)[b]	0.28 (0.56)
Adjusted R^2	0.160	0.02
F Value	442.12[b]	41.45[b]

[a]Regression analysis performed using data from the 1989 Consumer Expenditure Survey (U.S. Department of Labor, 1991a).
[b]Denotes significance at the one percent level.

services, and indirect costs are the total value of time. Indirect costs can also be thought of as foregone income. Both direct and indirect costs are included in the full cost of the commodity.

The full cost for dry cleaned clothing to the household, C, is defined as follows:

$$C = p*q + t*d + s*r \qquad (3.9)$$

where

- p = the unit price of dry cleaning services (commercial or coin-operated),
- q = the quantity of dry cleaning,
- t = the cost per mile of transportation to a dry cleaning facility,
- d = the distance in miles to a dry cleaning facility,
- s = the unit value or opportunity cost of time per hour, and
- r = the time in hours required to drop off and pick up clothing (plus the time required to clean and press clothing in a coin-operated facility).

This cost measures the cost of a single trip to a dry cleaner, which it will vary with quantity because consumers can take one garment or many garments to the cleaner in a single trip. In addition, the cost for coin-op consumers will vary with quantity not only in terms of the cost of using the facility but also with respect to the opportunity cost of time, which will also increase with quantity.

The critical wage is based on the full cost of dry cleaning at commercial and coin-operated facilities. The first component of the full cost is the direct cost or the price charged by the dry cleaning facility. This is $6.34 per kilogram for commercial facilities and $1.65 per kilogram for coin-operated facilities (see Section 2 for explanation).

The second component is the opportunity cost of the time an individual must spend to operate the machine and press the garment. That cost will vary from individual to individual and will depend on that individual's wage rate. One cycle in a 3.6 kilogram machine takes approximately 45 minutes to complete, which converts to 0.20625 hours per kilogram. Assuming an individual takes approximately 30 minutes to press a man's suit, total time spent would be 0.70625 hours/kilogram.

Assuming that the distances to a commercial facility and a coin-operated facility are the same eliminates any transportation costs from the calculation.

The critical wage can then be calculated by solving the equation below for x.

$$\$1.65 + 0.70625x = \$6.34 \tag{3.10}$$

$$0.70625x = \$4.69$$

$$x = \$6.64$$

For individuals earning less than \$6.64/hour, using the coin-operated facility would be more cost-effective. For individuals earning more than \$6.64/hour, using the commercial facility would be more cost-effective.

The foregoing analysis is contingent on the relative price of coin-operated versus commercial dry cleaners. If the proposed regulation did not affect the coin-operated sector but raised the price of commercial cleaning services, then the critical wage at which consumers would switch from coin-operated to commercial would be higher. This higher wage implies that more consumers would utilize coin-operated facilities.

The individual's choice assumes that both types of facilities are readily accessible, but this may not be the case for some smaller or rural communities. These locations may have only one cleaning facility, and the value of time may be irrelevant. Coin-operated facilities are not distributed uniformly throughout the United States but tend to be concentrated in the southeastern and mid-atlantic states. Despite the concentration of facilities, consumers in these areas, depending on the elasticity of demand for dry cleaning, may choose not to dry clean. The sensitivity to price of dry cleaning is discussed below.

3.1.5 Sensitivity To Price

Consumers' sensitivity to the price of dry cleaning services depends on other alternatives, which can vary from garment to garment. Some fabrics require dry cleaning for proper care, whereas others can also be cleaned with detergent and water. Specialty fabrics like leather, suede, and silk are usually labeled "dry clean only." Consumers are often uncertain about which fabrics can safely be laundered without being damaged. Therefore, the importance of dry cleaning services to consumers varies with the ease with which another cleaning process can be substituted for dry cleaning and the consumer's knowledge of the possibilities of substitution.

A few indirect substitutes are available to replace dry cleaning. In the long run, consumers could replace the stock of clothes requiring dry cleaning for proper care with water-washable garments. In the short run, they could reduce the frequency of wearing dry-cleaned clothing or increase the number of times a garment is worn before it is cleaned. The only direct substitute available for dry cleaning is laundering with water and detergent, but this method is not a perfect substitute.

The price elasticity of demand is one way of measuring consumers' sensitivity to price changes. Demand is said to be price elastic if an increase (or decrease) in price causes a proportionately greater decrease (or increase) in purchases. Thus, elasticity of demand measures consumers' responsiveness to price changes. Section 4 presents price elasticity estimates and results.

3.2 INDUSTRIAL DEMAND

Many industries provide uniforms for their employees typically renting these uniforms from an industrial launderer. The industrial customer is charged a price per-uniform change and receives clean, delivered uniforms on a regular basis. Unlike households, however, industrial customers are indifferent to whether the uniforms are water washed or dry cleaned. They pay the same price regardless of how the garment is cleaned.

Historically, changes in general economic conditions have affected industrial cleaners less dramatically than coin-operated and commercial sectors. As industrial production and employment increase, so does the demand for industrial uniform rentals, the main item leased and cleaned by the industrial sector (Betchkal, 1987a).

3.2.1 Consumption and Trends

Data are not available on the consumption of industrial dry cleaning services. The fact that customers are indifferent to the cleaning method and pay the same price for uniforms laundered in water and detergent as they do for uniforms cleaned in PCE probably explains the lack of information. Furthermore, dry cleaning is typically a very small part of an industrial launderer's business. Total industry receipts are available from the 1987 Census of Service Industries (U.S. Department of Commerce, 1990b). For the years 1982 and 1987, receipts of industrial launderers totalled $2,435 million and $2,947 million in constant (1989) dollars. This increase amounted to over 21 percent.

3.2.2 Characterization of Demanders

Customers of industrial cleaners encompass many industries. Industries that typically rent uniforms include auto dealerships and independent garages, construction, hotels, restaurants, security firms, food processing, and other manufacturing industries. Even traditionally white collar industries such as banking or real estate may rent blazers for their employees. Many types of additional industries are likely to lease the other items offered by industrial cleaners, such as mats, mops, towels, and cloths. All of these firms use these products as inputs in their production process.

3.2.3 Derived Demand

Unlike the demand for commercial and coin-operated dry cleaning services, the demand for industrial cleaning services is a derived demand. Customers of industrial cleaning view clean uniforms as inputs into their production processes, so demand for these inputs is said to be derived because it depends on the demand for the final good. Additional inputs are purchased in anticipation of increasing production of the final good. As discussed in Section 3.2.4, the elasticity of demand for an input is related to the elasticity of demand for the final product.

In such a scenario, producers would maximize profits. Presumably, the full-cost model for industrial dry cleaning services would be as follows:

$$C = p^*q + T \tag{3.11}$$

where

p = the unit price of dry cleaning services

q = the quantity of dry cleaning services

T = transaction costs associated with purchasing dry cleaning services.

Transportation costs do not play a role here because industrial launderers deliver the uniforms and do not charge different prices based on distance.

3.2.4 Sensitivity to Price

The elasticity of demand for industrial dry cleaning services is not estimated for this analysis due to a lack of data. However, a theoretical model is developed that expresses the elasticity within a range of values. This model is based on the concept of the elasticity of substitution for inputs and the cost share of inputs.

The elasticity of substitution measures the ease with which a producer can substitute between inputs, holding final output constant. When substitution is difficult (i.e., when changing the input mix does not improve the efficiency of the inputs), the elasticity of substitution will be less than one. In a fixed proportion production function, the elasticity of substitution is zero because inputs must be used in a fixed ratio, and altering that ratio would be inefficient. The customers of industrial dry cleaners encompass many types of final products, so generalizing about the elasticity of substitution with respect to inputs of clean uniforms is difficult. However, clean uniforms will probably be used in fixed proportions, or, at the very least, difficult to substitute. The elasticity of substitution with respect to clean uniforms must fall between zero and one.

The second concept used in the model is the cost share of inputs. The cost share simply represents the cost of a specific input as a percentage of the total cost. The framework established by Allen (1962) suggests a theoretical estimation of the elasticity of demand for an input. In the following equation, the elasticity is expressed as a proportional change.

$$E(Q_a) / E(P_a) = (\Delta Q_a/Q_a) / (\Delta P_a/P_a) = -(k_b\delta + k_a\lambda_x) \qquad (3.12)$$

where

a = inputs of clean uniforms

b = all other inputs

Q_a = the quantity of clean uniforms

P_a = the price of clean uniforms

k_b = the cost share of all other inputs

δ = the elasticity of substitution between uniforms and other inputs

k_a = the cost share of clean uniforms

λ_x = the elasticity of demand for the final product.

The cost share of all inputs other than clean uniforms is quite large, and the cost share of clean uniforms is nearly zero. The elasticity of substitution is most likely zero. Whatever the value of k_b, the first term in the above equation is zero or a very small number. k_a will be nearly zero and will limit the value of the second term of the equation to nearly zero. The sum then is a small number, certainly less than one in absolute terms. Thus, the elasticity of demand for industrial dry cleaning services is somewhat inelastic.

One additional point merits mention. Empirical studies have shown that the elasticity of demand for final goods is generally greater than demand for intermediate goods (Martin, 1982). The elasticity estimation of the demand for dry cleaning services for households and for industrial consumers is consistent with that finding.

SECTION 4

MARKET STRUCTURE IN THE DRY CLEANING INDUSTRY

A causal flow occurs from demand and supply conditions to market structure and from market structure to conduct of firms (Sherer, 1980). Economic theory provides a framework for analyzing the links between the demand and supply conditions an industry faces, its market structure, and the typical behavior of firms in that industry. This section examines market structure in the dry cleaning industry and develops an approach for estimating the impacts of an increase in the cost of supplying dry cleaning services due to regulation. Certain aspects of market structure--including the existence of barriers to entry, the number of sellers in a market area, and the geographic distribution of consumers and producers--are particularly relevant for determining the way consumers and suppliers would react to a change in the costs of providing dry cleaning services.

Fundamental to the analysis of market structure in the dry cleaning industry is an understanding of the geographic scope of the market area. To facilitate this understanding, this section begins with a brief description of the facility location decision, which is determined by the basic supply and demand conditions outlined in previous sections. The section then describes market structure in the three sectors prior to developing the model markets.

4.1 FACILITY LOCATION DECISION

Determinants of facility location differ by industry sector. In the commercial and coin-operated sectors, dry cleaning markets are small in geographic size. Depending on the number of sellers in a particular place and the population density, markets may cover an area as small as a few city blocks. In contrast, industrial facilities operate in geographic markets that are much larger. Factors such as the income distribution of the customer base, traffic patterns, and number of competing firms in an area contribute to the location decision in each sector. The determinants of the facility location characteristic of each industry sector are discussed below.

4.1.1 Commercial Dry Cleaners

The service provided by commercial dry cleaners is effective, fast, and requires little effort by the customer. These establishments sell a convenience good that, like toothpaste and gasoline, does not typically justify comparison shopping because the benefit of price comparison does not compensate for the cost of the search (Sherer, 1980; Steinhoff and Burgess, 1989). An important determinant of the convenience of dry cleaning is the proximity of the facility to the customer's home. The market that commercial dry cleaners serve extends over a local area although the geographic size will vary depending on population density.

The profit-maximizing dry cleaner evaluates multiple dimensions when choosing the location of a new facility (Steinhoff and Burgess, 1989). Some considerations are highly specific to the community and, while they are crucial to the firm's potential success, have little bearing on the economic impact analysis because they do not provide insight into the responses to regulation. Among these dimensions are the availability of parking, types of surrounding firms, traffic density, and side of the street for the facility. Other dimensions such as rent, availability of labor, the local business climate, and the share of the population in professional or managerial occupation categories are also important to the potential for success, but again they are unlikely to be significant for the impact analysis.

The significant dimensions of the location decision for commercial dry cleaning facilities are the size of the consumer base and the efficiency of the existing firms. An increasing population in the area under consideration may provide the basis for a new firm. In the absence of an expanding market, the presence of inefficient firms may instead provide the basis. In either case, the potential customer base must be at least large enough to generate sufficient revenues to justify investment in the minimum size facility.

The minimum size facility implies a minimum population requirement, which, because of limits on the size of dry cleaning equipment, may be several thousand people (the population requirement would increase as average income decreases). The technology of dry cleaning is "lumpy": dry cleaning machines used by the commercial sector are available in about six sizes. The smallest machine used in this sector has a capacity of 11.3 kilograms per load. The operation of a dry cleaning facility also requires labor for staffing the front counter, preparing clothing for cleaning, operating the dry cleaning machine, and processing the clean clothing for return to the customer. In reality, labor is also unavailable in an infinitely divisible quantity. Facility size is therefore imperfectly variable.

A potential owner of a dry cleaning facility confronts a definite lower limit on the revenue that is necessary for profitable operation. In choosing a location for a dry cleaning facility, the profit-maximizing potential owner must consider the minimum customer base that this lower limit on revenue implies. Owners who misjudge their customer base, either because of miscalculation or over-confidence in their ability to attract customers away from an existing facility, may be unable to cover their fixed costs or even their variable costs. Inability to cover fixed costs can lead to financial failure of the firm. Inability to cover variable costs can lead to closure of the facility.

4.1.2 Coin-operated Dry Cleaners

Many of the determinants of the facility location decision that are characteristic of the commercial sector are also characteristic of the coin-operated sector. In particular, coin-operated laundries that offer plant-operated services provide a convenience good that is virtually indistinguishable from the service offered by the commercial sector. Like commercial facilities, coin-operated facilities serve a local market area and typically locate in places that are convenient to consumers.

One important difference does exist, however. As discussed in Section 2, dry cleaning services are offered as an auxiliary to the regular laundry operations at coin-operated facilities. Because dry cleaning activity accounts for only about 10 percent of receipts at coin-operated facilities with dry cleaning operations, the location decision is based on the determinants relevant for locating a laundromat rather than for a dry cleaning facility. Once the decision to locate the coin-operated laundry is made, the owner must decide whether to provide dry cleaning services in addition to the regular laundry services. Relevant factors in this secondary decision include the proximity of other dry cleaning facilities, the size of the costumer base, and the income distribution of residents within the community.

4.1.3 Industrial Dry Cleaners

Industrial cleaners serve a much larger geographic area than do commercial or coin-operated cleaners. For example, the operator of one industrial facility indicated that his facility served industrial and commercial users located as far away as 100 miles (Coor and Grady, 1991). Services provided by industrial cleaners are not considered convenience goods. Consumers in this sector view the services provided by industrial cleaners as an input into their production process. Because the cleaner delivers the cleaned items, consumers are generally more concerned with dependability of service than with convenience.

The profit-maximizing industrial cleaner locates where costs of production are minimized. According to one facility operator, the ideal location is a small town that is centrally located to several large cities where the customer base is located (Coor and Grady, 1991). Small towns typically do not have the traffic congestion characteristic of larger cities. Traffic congestion ties up delivery vehicles, which increases the cost of delivery and may reduce customer satisfaction. In addition, small towns tend to have less expensive land and building costs and labor costs. Because industrial launderers clean most of the items they process in water and detergent, a cheap, abundant water supply is also an important determinant of location.

4.2 MARKET STRUCTURE

Within each sector of the industry many localized geographical markets exist where only neighboring firms compete directly. These submarkets are only loosely tied to a national market, but economic decisions by individual firms are jointly related to national trends. The existing market structure reflects fundamental market forces that are likely to be an enduring feature of the dry cleaning industry. The economic impact analysis uses the differences in market structure and pricing practices of dry cleaning facilities to predict the market responses to the candidate regulatory alternatives. To simplify the analysis, a model market approach is used to differentiate markets by

- the market sector,
- the number of suppliers in each market area, and
- the share of suppliers potentially affected under each regulatory alternative.

An important economic impact associated with promulgation of the candidate regulations is the total welfare loss (gain) attributable to market adjustments in the dry cleaning industry. A neoclassical supply/demand analysis is developed for each sector and model market. The economic impacts are analyzed for each sector and model market individually and the results are then aggregated to determine total welfare effects.

4.2.1 Market Structure in the Commercial Sector

Two basic market structures are prevalent in the commercial sector. The first is a competitive structure, which is found predominantly in urban and suburban areas and characterized by the existence of many dry cleaning facilities in each market area and no barriers to entry. Approximately 90 percent of the commercial facilities are in urban/suburban market areas. The second type of market structure is characterized by a single facility in a rural market area. Because consumers are unwilling to drive long distances to purchase dry cleaning services, the owner of a single facility in a remote area does not behave as if in a perfectly competitive market.

Urban/Suburban Markets. Given the number of commercial facilities in urban and suburban areas and the size distribution of those facilities, it is assumed that a competitive market structure exists for these facilities. The competitive model is based on the hypothesis that no facility individually can influence market equilibrium, but the behavior of all producers taken together determines the position of the market supply curve. In addition, the cost of producing the last unit of output, the marginal cost, along with market demand determines equilibrium price and output. Furthermore, at a stable equilibrium price, each individual facility can sell any level of output desired, with no perceptible effect on equilibrium values. As a result, each facility faces an implicit demand curve that is perfectly elastic (horizontal) at the current market equilibrium price.

Initially, imposing controls on a facility will alter the costs of producing the same level of output as before the control. This production cost change will induce a shift of that facility's supply curve. Because the supply curve for a well-defined market is the horizontal summation of individual facility supply curves for all facilities participating in that market, the shift in the market supply curve can be determined from knowledge of facility-specific shifts. If the regulation results in a production cost change for the marginal supplier within the market area, a change in the equilibrium price and output will occur.

Precise estimates of the quantitative changes in price and output require information on the position and slope of the market supply and market demand curves both prior to and after the adjustment. Predicting the position and slope of the market supply and demand curves is, therefore, crucial to estimating the economic impacts. The changes in price and output lead to consumer and producer welfare changes that can be measured as areas within the supply/demand plane. The neoclassical supply/demand analysis applied to this study is introduced below.

The position of the market demand curve is critical to determining the change in equilibrium price and output resulting from a regulatory-induced shift in the market supply curve. The slope of the demand curve measures the responsiveness of quantity demanded to a change in the price of the service. The elasticity of demand is a relative measure of demand responsiveness and as a policy tool is generally preferred to the demand curve slope. The elasticity of demand is measured as the percentage change in quantity demanded of a good or service resulting from a one-percent change in its price. Post-regulatory equilibrium price and output values and the resulting welfare changes can be calculated if the baseline price and output values, the relative shift of the market supply curve, and estimates of demand and supply elasticities are available.

A priori, predicting the elasticity of demand for commercial dry cleaning services is difficult because many variables contribute to its value. If data are unavailable to estimate a demand elasticity, a unitary elastic

($\eta = -1.0$) demand curve could be used to estimate impacts, but considerable uncertainty would be associated with the price and output adjustments and the welfare loss estimates. Any market-measured value of the demand elasticity would obviously be superior to an unsubstantiated simplification. The supply and demand functions for the commercial dry cleaning sector are estimated simultaneously to derive corresponding elasticity estimates.

A neoclassical supply/demand model is a system of interdependent equations in which the price and output of a product are simultaneously determined by the interaction of producers and consumers in the market. In simultaneous equation models, where variables in one equation feed back into variables in another equation, the error terms are correlated with the endogenous (price, output) variables. In most circumstances, single-equation ordinary least-squares estimation of individual equations in a simultaneous equation model can lead to biased and inconsistent parameter estimates. Furthermore, the supply and demand equations must be econometrically identified prior to initiating a simultaneous equation regression procedure. An equation is identified if obtaining values of the parameters from the reduced-form equation system is possible. Put simply, identification requires that at least one original exogenous (shifter) variable is contained in each equation of the supply/demand system.

Section 2 presented data on average base prices and total output for the commercial sector from 1974 to 1988. These data represent equilibrium points of intersection between supply and demand curves for each of those years. Estimating a supply or demand curve equation from these data would be difficult because information is insufficient to completely identify the supply/demand system. However, with the aid of intuitively acceptable supply and demand shift variables, the price and output data can be used to econometrically estimate the commercial sector supply and demand functions and corresponding elasticities.

Gross population levels for the U.S. and the producer price index for service industries from 1974 to 1988 were chosen as the demand and supply shifters, respectively. Population levels are commonly used as demand shift variables in regression equations. The producer price index is suitable for the supply function because it is a good proxy for production costs. Table 4-1 lists the time-series data used in the supply/demand estimation.

TABLE 4-1. DATA USED IN THE SUPPLY/DEMAND ESTIMATION

Year	Price ($/kg)[a]	Output (10^6 kg/yr)[b]	P.P. Index	Population (10^6)
1974	4.02	570	53.5	213.[illegible]
1975	4.42	506	58.4	216.0
1976	4.46	499	61.1	218.0
1977	4.36	521	64.9	220.2
1978	4.87	493	69.9	222.6
1979	4.90	499	78.7	225.1
1980	5.32	475	89.8	227.8
1981	5.63	444	98.0	230.1
1982	5.72	522	100.0	232.5
1983	5.87	527	101.3	234.8
1984	5.98	525	103.7	237.0
1985	6.13	522	103.2	239.3
1986	6.14	608	100.2	241.6
1987	6.05	603	102.8	243.9
1988	6.08	596	106.9	246.1

[a] All dollar figures converted to 1989 dollars through the Consumer Price Index for Apparel and Upkeep.
[b] See Table 2-8.

Source: Faig (1990); Survey of Current Business (U.S. Department of Commerce 1989b); Statistical Abstracts of the U.S. (U.S. Department of Commerce 1989a).

Supply and demand equations for the commercial sector were econometrically estimated by using the instrumental variables regression procedure. Base price and total output were first converted to natural logarithm form to ensure constant supply and demand elasticity estimates. The structural models for the supply/demand system are the following:

$$\text{Supply:} \quad Ln(Q_t^s) = a_1 + a_2 Ln(P_t) + a_3 PPI_t + d_t, \tag{4.1}$$

$$\text{Demand:} \quad Ln(Q_t^d) = b_1 + b_2 Ln(P_t) + b_3 Pop_t + u_t, \tag{4.2}$$

$$Ln(Q_t^s) = Ln(Q_t^d), \tag{4.3}$$

where Q = output, P = price, Pop = population, and PPI = producer price index. The supply equation (4.1), demand equation (4.2), and equilibrium condition (4.3) determine the market price and the quantity supplied (demanded) when the market is in equilibrium. For this reason, the variables $Ln(Q_t^s)$, $Ln(Q_t^d)$, and $Ln(P_t)$ are endogenous because they are determined within the system of equations, while Pop and PPI are exogenous variables. The parameter estimates and regression statistics from the simultaneous system estimation are reported in Table 4-2.

With Durbin-Watson statistics of 1.54 for both the supply and demand equations, the null hypothesis of no serial correlation cannot be rejected at the 0.01 level of significance. Overall, the significance of the parameter estimates and the low standard errors indicate that base prices, dry cleaning output, population levels, and the producer price index are effective in predicting the supply/demand relationship.

Parameter estimates were also developed using a time variable instead of population in an attempt to determine whether a simple time trend would be a more suitable demand shifter. The results of that regression are reported in Table 4-3. The parameter estimates are very similar to the regression with population as an explanatory variable, but the population specification had a slightly better fit. As a result, all future references to the elasticity estimates will apply to the population specification.

The predicted elasticity of supply and demand can be derived directly from the parameter estimates of the regression system. Regression equations for the supply and demand functions appear in estimated form as

$$Ln(Q_t^s) = -0.012 + 1.558 Ln(P_t) - 0.023(PPI_t), \tag{4.4}$$

$$Ln(Q_t^d) = -6.351 - 1.086 Ln(P_t) + 0.036(Pop_t). \tag{4.5}$$

TABLE 4-2. PARAMETER ESTIMATES AND REGRESSION STATISTICS FROM THE SUPPLY/DEMAND ESTIMATION

Parameter	Value	Std. err.	t-stat	95% conf. int.
Supply Curve				
Intercept	0.120	0.064	1.882	-
Price	1.558	0.291	5.361	0.924 to 2.192
P.P. Index	-0.023	0.005	-5.057	-0.033 to -0.013
	Sum sq. res.	Std. err.	DW test	
	0.031	0.051	1.54	
Demand Curve				
Intercept	-6.351	1.289	-4.927	-
Price	-1.086	0.240	-4.530	-1.608 to -0.564
Population	0.036	0.007	5.057	0.020 to 0.051
	Sum sq. Res.	Std. err.	DW test	
	0.031	0.051	1.54	

The first derivative of the supply equation with respect to the logarithm of price (1.558) is an estimate of the supply elasticity for dry cleaning services in the commercial sector. The interpretation of this estimate is that the quantity supplied of dry cleaning services will increase by 1.558 percent for every 1 percent increase in the price for that service. The t-statistic value of 5.361 allows rejection of the null hypothesis so that the estimate is not significantly different from zero at the 0.05 level of significance.

The estimated elasticity of demand is the first derivative of the demand equation with respect to the logarithm of price, or -1.086. The interpretation of this value is that the demand for dry cleaning services will decrease by 1.086 percent for every 1 percent increase in the price of that service. The t-statistic value of -4.530 allows rejection of the null hypothesis that the estimate is not significantly different from zero at the 0.05 level of significance.

TABLE 4-3. PARAMETER ESTIMATES AND REGRESSION STATISTICS FROM THE SUPPLY/DEMAND ESTIMATION (TIME-TREND SPECIFICATION)

Parameter	Value	Std. err.	t-stat	95% conf. int.
Supply Curve				
Intercept	0.123	0.067	1.825	–
Price	1.512	0.305	4.959	0.848 to 2.176
P.P. Index	-0.022	0.005	-4.670	-0.033 to -0.012
Sum Sq. Res.		Std. Err.		DW test
0.345		0.054		1.46
Demand Curve				
Intercept	1.082	0.208	5.198	–
Price	-0.989	0.239	-4.141	-1.509 to -0.469
Time	0.077	0.016	4.670	0.041 to 0.112
Sum Sq. Res.		Std. Err.		DW test
0.345		0.054		1.46

The credibility of the demand elasticity estimate can be confirmed with a demand elasticity point estimate computed by Houthakker and Taylor (1970). These authors examined consumer demand relationships for many different goods and services. The demand elasticity for a category of products they refer to as "clothing upkeep and laundering in establishments" was estimated at 0.9293. This value is contained in the 95 percent confidence interval for the demand elasticity estimate reported in Table 4-2 (-1.608 to -0.564). In addition, it is very close to the point estimate itself (-1.086).

If the regulation results in a change in the marginal supplier's cost of providing dry cleaning services, then price and quantity impacts will occur in the short run. Using the demand and supply elasticities estimated above, projecting changes in short run equilibrium price and quantity associated with each regulatory alternative is possible. As noted in Section 2, the baseline price in the market is equivalent to the marginal cost of providing dry cleaning services (before the regulation) and the average total cost of building a new facility. An increase in the marginal costs projected under the regulatory alternatives would result in an increase in price in the short run. As price rises above the average total cost of a new facility, new entry is encouraged. The average total cost of the new facility, however, is not affected under any of the alternatives considered because virtually all new dry cleaning machines have built-in vent controls. Consequently, in the long run, price and quantity adjustments are zero. In the absence of regulation, the current stock of uncontrolled PCE machines would have been replaced by new machines with vent controls, further supporting the position that long-run price and output adjustments are zero. Therefore, price and output adjustments in the balance of this analysis refer to short-run effects.

Not all commercial facilities in a market area are affected under the candidate regulatory alternatives. Only those facilities that use PCE and that do not have the required vent controls in the baseline will experience a change in production costs. It is not known whether facilities that are potentially affected are more or less likely to be the price-setting marginal facility in the market. Without detailed information on individual supplier's production costs, determining whether the marginal supplier will incur regulatory costs is impossible. Therefore, it is assumed that the likelihood of a shift in the marginal supplier's costs is directly related to the proportion of facilities experiencing the cost increase.

Suppose that a given market area includes facilities that are potentially affected by the regulation (PCE facilities that do not have the required vent controls) as well as those that are unaffected (PCE facilities that have the required vent controls or non-PCE facilities). If the unaffected facilities dominate, then price and output adjustments are unlikely. The impact in markets where unaffected facilities dominate falls exclusively on the affected suppliers whose profits are reduced by the cost of the regulation. Conversely if affected facilities dominate in a particular market area, then the regulation is likely to result in an equilibrium price and output adjustment for that market. Price would rise, but not by the full amount of the cost increase, until demand and supply are in equilibrium. Put differently, the market supply curve will shift along a (stationary or shifting) market demand curve with equilibrium changes in price and output determined once the curves stabilize.

Rural Markets. Considering the minimum-size customer base, as described in Section 4.1.1, is critical for owners planning to open a facility in a remote area served by a single facility. Areas with a lower population density can sustain a lower density of dry cleaners than areas with a higher population density. The existence of a minimum customer base explains the pattern observed in the data set: sparsely populated areas are served by a single facility and densely populated areas by multiple facilities.

The outstanding characteristic of the structure of the dry cleaning industry in rural communities is the prevalence of markets that are served by a single facility. Another salient characteristic of rural dry cleaning facilities is that annual revenues are typically below $25,000. The small scale of the market in rural communities requires the operation of a minimally sized facility. Consequently, the smallest facility would use an 11.3 kilogram machine. A new entrant would at a minimum add another 11.3 kilograms of capacity. The only option available to a new entrant, therefore, is to double (at the minimum) capacity in the market.

Although these single-facility markets are not perfectly competitive, the ease of entry into the dry cleaning industry implies that the threat to long-run profits from new entrants is keen and persistent. The optimal pricing strategy is to set a profit-maximizing price that is low enough to deter entry. Therefore, to model the economic impact of the proposed regulations, it is assumed that the owners of firms in single-facility rural markets follow a limit pricing strategy. The assumptions of potential large-scale entry and output maintenance allow application of the theory of limit pricing developed by Bain, Sylos-Labini, and Modigliani (Sherer, 1980).

Any price above the average total cost of a new facility would encourage new entry into the market. The existence of a second facility in the market would decrease the market share and the total revenue of the initial supplier. Assuming that the productivity of dry cleaning equipment has been increasing over time, owners of new equipment would tend to have lower marginal costs than owners of older equipment. Therefore, the market price would probably decline with the entrance of a second facility, further decreasing the total revenue of the existing supplier. Furthermore, if the assumption of increased productivity is correct, owners of new facilities may be able to set prices at a level where initial suppliers would not be able to cover their costs of production. If the price set by the new supplier fell below the variable costs of production for the initial supplier, then the initial supplier would cease operations. If the initial supplier could cover variable costs but not all the fixed costs of production, then the facility would continue to operate in the short run but would face potential financial failure. Facing this potential erosion in profits and/or financial failure, the owner of an existing facility is most likely to adopt the pricing strategy that presents the strongest deterrent to a potential entrant to ensure that his market share is not eroded.

Even in the pre-regulatory baseline, the new entrant's long-run average cost curve already reflects the cost of compliance associated with the candidate regulatory alternatives because the manufacturers of dry cleaning machines have incorporated the requisite air pollution control devices into the basic design (Federal Register, 1989). Therefore the pre-regulatory and post-regulatory costs of potential new entrants are the same, implying that the limit price set by an existing facility would not change under any of the regulatory alternatives.

Two types of rural markets must be analyzed: those with an unaffected facility and those with a potentially affected facility. In market areas with a single unaffected facility, costs do not change because the dry cleaning machines either already comply with the alternatives or they use a solvent other than PCE. Only in those market areas with a single potentially affected facility where regulatory costs are projected, does a potential exist for economic impacts.

The theory of limit pricing to deter large-scale entry implies that the established firm sets a price just below that at which a new entrant would find entry profitable. An established dry cleaner cannot raise its price without inducing entry and eroding its profits. Even when its costs rise, the established owner does not have an incentive to adjust price and quantity because new entry would occur and the market price would fall. Therefore, in rural, single-facility markets in which the alternatives considered for proposal have an economic impact, the impact falls exclusively on the established dry cleaners whose profits fall by the amount of the compliance cost.

4.2.2 Market Structure in the Coin-operated Sector

Conversations with industry representatives indicate that a perfectly competitive market structure is an accurate representation of current conditions in the coin-operated sector. In addition, the characteristics of supply and demand for coin-operated dry cleaning services and the determinants of facility location decision are similar to those described for the commercial sector, which is predominantly characterized by a competitive market structure. Therefore, a competitive market structure is used to estimate impacts in the coin-operated sector.

Coin-operated (plant-operated) facilities provide the same services to the same consumers at approximately the same prices as commercial facilities. Therefore the demand and supply elasticities estimated for the commercial sector are used to compute impacts in this sector. The service offered by self-service coin-operated facilities is different from that offered by commercial facilities or plant-operated facilities. As described in Section 2, the dry cleaning service offered by self-service facilities does not include pre-spotting, pressing, or finishing. However, historical data on price and output are not collected in a structured format for the coin-operated sector. As a result econometrically estimating supply and demand elasticities for self-service coin-operated dry cleaning is impossible. One option is to assume that the elasticity estimates for the commercial sector are representative of the market conditions characteristic of self-service dry cleaning. Another option is to compute a rough estimate of demand elasticity for self-service dry cleaning using the market price and output for self-service dry cleaning and the market price for commercial dry cleaning. This second option is described below.

First, a "choke price"--the price at which the quantity of self-service coin-operated dry cleaning demanded is zero--is estimated. As discussed in

Section 3, the consumer's full cost of obtaining dry cleaning services includes the price paid to the supplier plus the consumer's opportunity cost of time. Assuming that no consumer values time below the minimum wage rate, the minimum opportunity cost of time is the product of the minimum wage rate (4.25 per hour) and the time required to produce a clean suit ready to wear (0.70625 hours). Under these assumptions, the minimum opportunity cost of time associated with self-service dry cleaning is $3.00.

Commercial dry cleaning services, as well as the services offered by plant-operated facilities in the coin-operated sector, are a perfect substitute for the services offered by self-service coin-operated facilities. In other words, if the consumer's full cost of producing clean clothing using self-service cleaning rises above the full cost of producing clean clothing using the services of a commercial cleaner, then the consumer will use the services of the commercial cleaner. Presumably no consumer is willing to pay more than $3.34 per kilogram--the commercial dry cleaning price ($6.34) less the minimum opportunity cost of time ($3.00)--for self-service dry cleaning. This is the choke price or the price above which quantity of self-service dry cleaning demanded falls to zero.

Figure 4-1 shows the demand curve implied by the choke price and the market price and quantity. This interpretation of the demand curve assumes that demand is linear. This choke price combined with the market price and quantity for self-service dry cleaning can be used to compute demand elasticity in the following manner:

$$\eta = \frac{\Delta Q}{\Delta P} * \frac{P}{Q} \tag{4.6}$$

where η is the absolute value of demand elasticity, Q is the market quantity, and P is the market price. Because demand is downward sloping, elasticity is negative. At the market price of $1.65 per kilogram, market quantity of 577,239 kilograms, and a choke price of $3.34, demand elasticity is -0.9476.

Because consumers have a perfect substitute for self-service dry cleaning, even small increases in price are likely to result in large quantity reductions. In other words, the existence of a perfect substitute implies

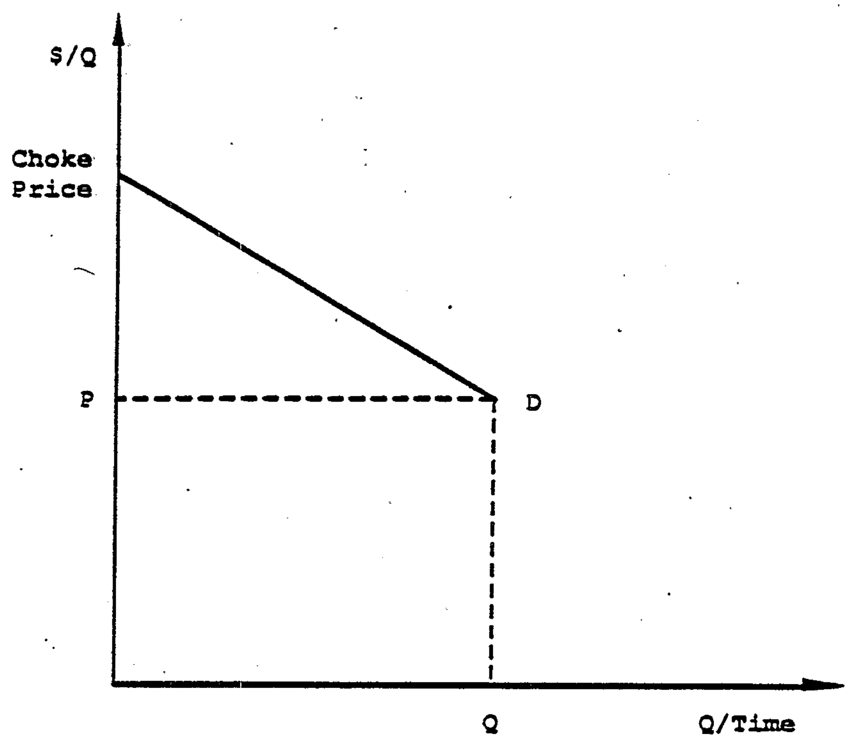


Figure 4-1. Demand for Self-Service Dry Cleaning

that the demand for self-service dry cleaning is likely to be more elastic than the demand for commercial or coin-operated (plant-operated) services. The estimate computed above, however, implies that the demand for self-service dry cleaning is slightly less elastic than the demand for commercial dry cleaning. The reason for the counterintuitive result may lie in the assumptions used to compute the demand elasticity.

First, the demand for self-service dry cleaning is assumed to be linear. To the extent that this assumption does not specify the demand curve, the elasticity estimate may also be miscalculated. In addition, the minimum opportunity cost of time may be underestimated. A higher opportunity cost of time would yield a lower choke price and a higher elasticity estimate (in absolute value). Because of these limitations, the demand and supply elasticity estimates computed for the commercial sector are used to compute impacts for self-service coin-operated facilities.

Data are not available on the number of facilities in this sector operating in markets where unaffected facilities dominate or vice versa. Therefore it is assumed that each market area has the same distribution of affected and unaffected facilities. Virtually all self-service dry cleaning and more than half of the plant-operated facilities in the coin-operated sector are uncontrolled. Therefore, the marginal cost of providing coin-operated dry cleaning services is likely to increase resulting in price and output adjustments for this sector.

The magnitude of the price and output adjustments in the coin-operated sector is limited by the adjustments in the commercial sector. These adjustments are computed separately for self-service and plant-operated facilities because of the difference in the type of service offered and the base price charged by these facilities. Plant-operated facilities are limited in the price increase that may be passed along to consumers because these facilities operate in markets dominated by commercial facilities. Price effects at self-service facilities are also limited by the projected price adjustments in the commercial sector. The post-regulatory price at self-service facilities may not exceed the choke price based on the post-regulatory price charged by commercial facilities. The post-regulatory choke price is the post-regulatory commercial price less the estimated minimum opportunity cost of time ($3.00) computed above.

4.2.3 Market Structure in the Industrial Sector

Industrial facilities also operate in perfectly competitive markets. However, no price and output adjustments are likely to occur in this sector for several reasons. First, water and detergent are near-perfect substitutes for PCE because virtually all of the garments dry cleaned by industrial facilities are water-washable. Because consumers do not dictate the cleaning method used, facilities facing a regulatory cost with continued PCE usage would likely substitute water washing for dry cleaning assuming sufficient capacity is available. Second, industrial cleaners do not charge different prices for garments cleaned in water and detergent and garments cleaned in PCE (Coor and Grady, 1991); also, over 92 percent of the output from industrial facilities is from regular laundry operations. This second factor is evidence that the cost of producing the marginal unit of output in the market area is not likely to increase under any of the alternatives considered for proposal. For these reasons, producers would not be able to pass along any regulatory cost in the form of a price increase.

4.3 MODEL MARKETS

To facilitate computing impacts of the regulatory alternatives, actual dry cleaning facilities have been allocated among model markets. The methodology used to develop the model markets is discussed below.

4.3.1 Commercial Sector Markets

Six model markets represent the commercial sector and are differentiated by

- rural and urban areas,
- the proportion of affected and unaffected facilities,
- the income distribution of facilities represented, and
- the behavioral response to a cost increase.

Data from American Business Information (ABI) (1991) compiled from telephone yellow pages provided the location of commercial dry cleaning establishments in the United States. Population data from the 1988 City and County Data Book (U.S. Department of Commerce, 1988) were merged with the establishment data from ABI to determine the portion of facilities in rural and urban areas.[1] Additional data on the extent of current state regulations, the percentage of facilities that use PCE in the dry cleaning process, and the share of PCE facilities that have machines with baseline vent controls were used to allocate facilities to each model market (Radian, 1991c; Safety-Kleen, 1986; Radian, 1991c).

Table 4-4 reports the total number of facilities and the number of facilities potentially affected and unaffected by the regulation in each model market of the commercial sector. An estimated 3,149 facilities (10.32 percent of all commercial facilities) are located in rural areas. Rural markets are represented by Model Markets A and B. It is assumed that all facilities in

[1]A rural area is defined as a locale with a population of 2,500 or less that is not part of a metropolitan statistical area.

these model markets are small establishments that receive $25,000 or less in annual revenue. In addition, it is assumed that these small rural areas have only one facility providing commercial dry cleaning services for the entire market area. Market A represents those areas with a single facility that is unaffected under the alternatives considered for proposal. No economic impacts are estimated for markets represented by Market A. Market B represents those areas with a single facility that is potentially affected

TABLE 4-4. PROFILE OF MODEL MARKETS IN THE COMMERCIAL SECTOR

Market Model	Market Description[a]	Proportion of Affected and Unaffected Facilities	Total Number Facilities[b]	Number of Potentially Affected Facilities[c]	Number of Unaffected Facilities[d]
A	Rural	Unaffected Only	1,543	0	1,543
B	Rural	Affected Only	1,606	1,606	0
C	Urban/ Suburban	Unaffected Only	1,157	0	1,157
D	Urban/ Suburban	Unaffected Dominate	10,432	287	10,145
E	Urban/ Suburban	Affected and Unaffected Evenly Distributed	8,073	4,038	4,035
F	Urban/ Suburban	Affected Dominate	7,683	4,298	3,385
Total			30,494	10,229	20,265

[a]Rural markets are defined as locales with population of 2,500 or less that are not part of a metropolitan statistical area. For this analysis, rural markets have only one facility per market area.

[b]Facilities are distributed to Model Markets based on the share of facilities located in urban and rural areas (ABI, 1991), the share of facilities that use PCE in the dry cleaning process (Safety-Kleen, 1986), and existing state regulations (Radian, 1991b).

[c]Potentially affected facilities are defined here as those that use PCE in the cleaning process and do not have vent controls in place (Radian, 1991c). The total is equivalent to the number of potentially affected facilities under Regulatory Alternatives I and II. Note that PCE facilities with baseline vent controls that do not meet the requirements of Alternative III are not included in the estimate of potentially affected facilities reported in this table.

[d]Unaffected facilities either do not use PCE in the cleaning process or have baseline vent controls.

under the candidate alternatives. These facilities may incur costs because of the regulation. However, as discussed in Section 4.2.2, no price increase is projected because facilities in this type of market practice limit pricing to deter new entry.

The share of facilities assigned to Markets A and B is estimated using data on the share of small facilities with baseline vent controls (Radian, 1991c) and data on the share of facilities that use PCE (Safety-Kleen, 1986). Of the 3,149 facilities in rural market areas, approximately 49 percent or 1,543 either have baseline vent controls or do not use PCE. These facilities are assigned to Market A. The remaining 1,606 facilities are assigned to Market B.

Urban/suburban commercial markets are represented by Model Markets C through F. These model markets are characterized as having more than one facility in each market area. Facilities of every income level operate in market areas represented by these urban/suburban model markets. Market C represents those urban/suburban markets where no commercial dry cleaning facilities are affected under the alternatives considered for proposal. Market D describes those areas where the unaffected facilities dominate. Potentially affected and unaffected facilities represented in Market E are roughly equivalent in number, and in Market F potentially affected facilities dominate.

Approximately 38 percent of all commercial dry cleaning facilities or about 11,589 facilities are located in states with stringent PCE requirements. Markets C and D are used to characterize the market for commercial dry cleaning services in these states. The number of facilities in markets represented by Market C is assumed to be one tenth of the facilities in states with strict PCE emissions standards or about 1,157. The remaining facilities located in states with strict PCE emission standards (10,432) are assigned to Market D. Price and quantity adjustments are assumed to be zero in these two model markets where unaffected facilities dominate.

Those facilities located in states that regulate only very large facilities are assigned to Market E. Market E represents 8,073 facilities or about 26 percent of all commercial establishments. Locales with no state regulations requiring vent controls for commercial facilities are allocated to Market F. In these two markets, some portion of the regulatory cost would be passed on to consumers in the form of a price increase. The price increases projected for Markets E and F are computed using the average cost increase per unit of output (kilograms of clothes cleaned) for the model facilities in the market area.

Facilities in each model plant category operating at each income level are allocated proportionally to each model market described above based on the total number of potentially affected and unaffected facilities assigned to each market. For example, Market A represents 1,543 facilities with annual receipts below $25,000. A total of 8,026 commercial facilities have annual receipts below $25,000. Therefore 1,543 out of 8,026 or 19 percent of the facilities receiving less than $25,000 in each model plant category are allocated to Market A. Facilities are allocated to Markets B through F in a similar manner. Using the model plants to represent average facilities in each market simplifies the analysis of impacts. Any shift in the model plant supply curve is augmented by the number of facilities in the market to determine the market supply curve shift.

4.3.2 Coin-operated Sector Markets

One model market represents all facilities in the coin-operated sector. Essentially two kinds of coin-operated plants are represented in the model market: self-service and plant-operated. The distribution between the two kinds of plants was based on actual plant information (Radian, 1991c). Seven percent of the facilities (or 213) are self service, and the remaining 93 percent (2,831) are plant-operated.

In the coin-operated market, the price and output adjustments computed for the regulatory alternatives are based on the average cost increase per unit of output measured in kilograms of clothing cleaned. The price adjustment in this sector is limited by the maximum adjustment computed for the commercial sector as discussed in Section 4.2.1. The highest price adjustments for the commercial sector are projected in commercial Market F where potentially affected facilities dominate. Consequently, projected price and output adjustments computed for Market F define the maximum adjustments for coin-operated facilities.

4.3.3 Industrial Sector Markets

One model market is used to compute impacts in the industrial sector. As discussed in Section 4.2.3, any regulatory costs are not passed along to the consumer in the form of price adjustments. Rather, the entire change in costs is absorbed by the producers.

SECTION 5

FINANCIAL PROFILE OF COMMERCIAL DRY CLEANING FIRMS

The dry cleaning NESHAP will potentially impact business entities that own commercial dry cleaning facilities. Behrens (1985) defines a business entity as a legal being that is recognized by law as having the capacity to conduct business transactions. The Census of Service Industries defines a firm as a "business organization or entity consisting of one domestic establishment or more under common ownership or control," and an establishment is in turn defined to be "a single physical location at which business is conducted."

A profile of the baseline financial condition of commercial dry cleaning firms will facilitate an assessment of the affordability, cost, and firm financial impacts of the dry cleaning NESHAP. The potential financial impacts on small businesses are of particular concern for two reasons. First, the dry cleaning industry is dominated by small businesses. Most firms have annual receipts of less than $100,000, and many have receipts totaling under $25,000. Second, the absolute control equipment costs are constant enough over machines of various sizes that the capital requirements may be disproportionately high for small businesses.

5.1 FIRM FINANCES AND FACILITY ECONOMICS

A facility, or establishment, is a site of land with a plant and equipment that combine inputs like materials, energy, and labor to produce outputs, like dry cleaning services. Firms are legal business entities that, in this context, own one or more facilities. This distinction between facilities and firms is an important one in economic and financial impact analyses.

The conventional theory of the "firm" is really a theory of the "establishment." The operator/manager of a facility--usually directly or indirectly the owner of a firm--maximizes short-run profit by setting the rate of output where marginal cost equals marginal revenue (price in perfect competition) as long as marginal revenue at least covers average variable cost. Economic failure describes the situation in which the decision maker closes the facility if marginal revenue/price is below marginal cost.

Altman (1983) draws the distinction between economic failure and bankruptcy. Economic failure is the inability of invested capital (facility) to continually cover its variable costs through revenues. Altman notes that a firm can be an economic failure for years as long as it never fails to meet its legal obligations because of the absence or near absence of enforceable debt, thus continuing to operate as a firm. Alternatively, a firm may own perfectly viable assets in an economic sense but earn insufficient profits to meet enforceable debts.

Because viable facilities can be owned by nonviable companies and viable companies can own nonviable facilities, a regulation that closes a facility may leave the company that owns it virtually unaffected. Alternatively, a regulation that would leave a facility viable after compliance may nonetheless cause a firm to become bankrupt or force it to sell the facility. The number of facilities closed by a regulation may exceed or be less than the number of firms forced to sell facilities and/or go bankrupt.

5.2 POPULATION OF POTENTIALLY AFFECTED FIRMS

Facilities subject to regulation under the NESHAP are generally classified in one of three four-digit Standard Industrial Classifications (SICs): 7215 (Coin-operated laundries and dry cleaning), 7216 (Dry cleaning plants, except rug cleaning), and 7218 (Industrial launderers). Nearly all industrial laundering facilities (SIC 7218) are already in compliance with the regulatory alternatives considered for proposal. In addition, those facilities that might be affected have a near-perfect substitute for dry cleaning--water laundering. Consequently, the financial impacts on industrial launderers are likely to be small, so these firms' finances are not characterized in this report.

A financial profile of coin-operated dry cleaning firms is also not presented, but for a very different reason. The economic impact analysis indicates that each of the alternatives considered would cause substantial price impacts and quantity impacts unless EPA exempts small facilities. EPA will thus probably exempt small coin-operated facilities, effectively exempting them all. Consequently, coin-operated dry cleaning firms will experience no financial impacts.

Effectively, this leaves commercial dry cleaning plants (SIC 7216) as the potentially affected population. A financial impact analysis of this industry is important for the following reasons:

- the economic impact analysis indicates that a significant number of facilities will be affected under each of the regulatory alternative unless a size exemption is established;
- most commercial dry cleaning firms are single-facility firms, so an affected facility is tantamount to an affected firm; and
- most dry cleaning firms have limited internal and external sources of funds because they are small businesses.

5.3 LEGAL OWNERSHIP OF COMMERCIAL DRY CLEANING FACILITIES

Business entities that own commercial dry cleaning facilities—hereafter "dry cleaning firms" or just "firms"—will generally be one of three types of entities:

- sole proprietorships,
- partnerships, and
- corporations.

Each type has its own legal and financial characteristics that may have a bearing on how firms are affected by the regulatory alternatives and on how the firm-level analysis of the NESHAP might be approached.

5.3.1 Sole Proprietorship

A sole proprietorship consists of one individual in business for himself who contributes all of the equity capital, takes all of the risks, makes the decisions, takes the profits, or absorbs the losses. Behrens (1985) reports that sole proprietorships are the most common form of business. Gill (1983) reports that approximately 78 percent of businesses are sole proprietorships. The 1987 Census of Service Industries reports that 8,494 of the 18,322 firms with payroll in this industry, or 46 percent, are sole proprietorships. The 1991 population includes another 7,500 dry cleaning facilities are without payroll. Although no evidence is available, presumably most of these nonpayroll facilities are small, are owned by single-facility firms, and are sole proprietorships. Assuming that 7,500 nonpayroll, sole proprietorship firms exist, of the 27,332 commercial dry cleaning firms in 1991, 16,694 (61 percent) are proprietorships (see Table 5-1).

Legally, the individual and the proprietorship are the same entity. From a legal standpoint, personal and business debt are not distinguishable. From an accounting standpoint, however, the firm may have its own financial statements that reflect only the assets, liabilities, revenues, costs, and taxes of the firm, aside from those of the individual.

Particularly relevant to the NESHAP analysis is that when a lender lends money to a proprietorship, the proprietor's signature obligates him or her personally and all of his/her assets. A lender's assessment of the likelihood of repayment based on the firm and personal financial status of the borrower is considered legal and sound lending practice because they are legally one-and-the-same. The inseparability of the firm and the individual complicates the assessment of credit availability and terms. Credit might be available to a financially distressed "firm" if the financial status of the individual is substantially strong to compensate. Alternatively, credit might be unavailable to a financially health "firm" if the financial status of the individual is sufficiently weak.

5.3.2 Partnerships

About 8 percent of U.S. business entities are partnerships (Gill, 1983). The 1987 Census of Service Industries reports that 1,666 of the 18,322 firms with payroll in 1987 in this industry, or 9 percent, are partnerships. An estimated 1,803 of all 27,332 dry cleaning firms operating in 1991 are partnerships (see Table 5-1).

A partnership is an association of two or more persons to operate a business. In the absence of a specific agreement, partnerships are general-with each partner having an equal voice in management and an equal right to profits, regardless of the amount of capital each contributes. A partnership pays no federal income tax. All tax liabilities are passed through to the

TABLE 5-1. LEGAL FORM OF ORGANIZATION OF DRY CLEANING FIRMS--NUMBER AND PERCENT

	Legal Organization			
Total Firms	Proprietorships	Partnerships	Corporations	Other
18,322[a]	8,494 (46.4%)	1,666 (9.1%)	8,147 (44.5%)	15 (0.1%)
27,332[b]	16,694 (61.1%)	1,803 (6.6%)	8,818 (32.3%)	17 (<0.1%)

[a]Payroll firms only 1987.

[b]1991 estimate; Payroll and non-payroll firms assuming payroll firms "added" since 1987 are distributed as 1987 payroll firms, and non-payroll firms are all proprietorships. There are an estimated 7,500 nonpayroll firms (Radian, 1991a).

Source: 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990b); 1987 Census of Service Industries, Nonemployer Statistics (U.S. Department of Commerce, 1990a).

individuals and are reflected on individual tax returns. Particularly germane is that each partner is fully liable for all debts and obligations of the partnership (Behrens, 1985). Thus, many of the qualifications and complications present in analyses of proprietorships (e.g., capital availability) are present--in some sense magnified--in analyses of partnerships.

5.3.3 Corporations

Even though only 14 percent of U.S. businesses are corporations, they produce approximately 87 percent of all business revenues (Gill, 1983). The 1987 Census of Service Industries reports that 8,147 of the 18,322 firms with payroll in this industry, or 44 percent, are corporations. Including the 7,500 nonpayroll proprietorships, 32 percent of all dry cleaning firms operating in 1991 are corporations (see Table 5-1).

Unlike proprietorships and partnerships, a corporation is a legal entity separate and apart from its owners or founders. Financial gains from profits and financial losses are borne by owners in proportion to their investment in the corporation. Analysis of credit availability to a corporation must recognize at least two features of corporations. First, they have the legal ability to raise needed funds by issuing new stock. Second, institutional lenders (e.g., banks) to corporations assess credit worthiness solely on the basis of the financial health of the corporation—not its owners. A qualification of note is that lenders can require (as a loan condition) owners to agree to separate contracts obligating them personally to repay loans.

5.4 DISTRIBUTION OF COMPANIES BY RECEIPTS SIZE

The U.S. has an estimated 27,332 commercial dry cleaning firms in 1991. An estimated 19,832 (73 percent) of these are firms with payroll; the balance (7,500 or 27 percent) includes firms without payroll. Estimating the distribution of dry cleaning firms by receipts size assumes that all seasonal, with-payroll firms have under $25,000 receipts and that 5,625 and 1,875 nonpayroll establishments are owned by as many nonpayroll firms with under $25,000 receipts and $25,000-$50,000 receipts, respectively (Radian, 1990c).

These estimates are presented in Table 5-2. Approximately three-fifths of all commercial dry cleaning firms have annual receipts of $100,000 or less. Almost one-quarter of the total have annual receipts below $25,000 (assuming all seasonal and most nonpayroll firms are included in this category). Only about 2 percent of all dry cleaning firms have annual receipts over $1 million.

Industry concentration is a good summary indicator of firm size distribution (see Table 5-3). The fifty largest commercial dry cleaning companies earn only about 9 percent of total industry receipts. This "fifty firm concentration ratio" is much lower than those for linen supply (63.1%), coin-operated laundries (30.5%), power laundries (28.5%), or industrial launderers (67.3%).

Firm size is likely to be a factor in the distribution of financial impacts of the NESHAP on dry cleaning firms. Dry cleaning firms differ in size for one or both of the following reasons:

- First, dry cleaning facilities vary widely by receipts (see Section 9.1 and Table 9-27). All else being equal, firms with large facilities are larger than firms with small facilities.

- Second, dry cleaning firms vary in the number of facilities they own. All else being equal, firms with more facilities are larger than those with fewer facilities (see Section 5.5).

TABLE 5-2. RECEIPTS OF DRY CLEANING FIRMS

Receipts Range ($000)	No. of Firms[a]	Receipts per Firm	No. of Establishments	Receipts per Establishment
<25	6,690	17,736	6,690	17,736
25-50	4,187	40,545	4,187	40,545
50-75	2,581	67,021	2,581	67,021
75-100	2,581	93,829	2,581	93,829
subtotal	16,039	—	16,039	—
100-250	6,823	171,219	7,032	166,130
250-500	2,870	366,915	3,382	311,368
500-1,000	1,122	722,394	1,836	441,463
1,000-2,500	389	1,504,998	1,130	518,092
2,500-5,000	60	3,640,043	424	515,100
>5,000	29	10,973,635	651	488,841
subtotal	11,293	—	14,455	—
Total	27,332	—	30,494	—

[a]1991 Estimate; Payroll and Non-Payroll Firms (includes plants that use PCE as well as those that use other solvents.). Nonpayroll firms include 5625 below 25,000 in annual receipts and 1875 with 25,000 to 50,000 in annual receipts (Radian, 1991a).

Source: 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990); Table 2-1.

TABLE 5-3. CONCENTRATION BY LARGEST DRY CLEANING FIRMS

	Percent of Industry Receipts[a]
4 Largest Firms	2.4%
8 Largest Firms	3.6%
20 Largest Firms	5.8%
50 Largest Firms	9.1%

[a]Payroll firms only, 1987.

Source: 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990b).

5.5 DISTRIBUTION OF COMPANIES BY NUMBER OF FACILITIES

The financial impacts of the NESHAP on two firms of equal size might depend significantly on their facility composition because substantial control economies of scale exist. The costs of controlling larger machines are not proportionately higher than the costs of controlling smaller ones. Also, the effective impacts on more fully utilized dry cleaning machines are smaller than on under-utilized dry cleaning machines. Because machine size and utilization underlie facility receipts, facility impacts will be greater for smaller than for larger facilities.

Control economies are facility-related rather than firm-related. Hypothetically, a firm with ten uncontrolled facilities of a given size may face approximately twice the control capital requirements of a firm with five uncontrolled facilities of the same size. Alternatively, two firms with the same number of facilities facing approximately the same control capital costs may be financially affected very differently if the facilities of one are larger than those of another.

An estimated 27,332 firms own 30,494 commercial dry cleaning establishments in 1991: an average of 1.12 facilities per firm. An estimated 95 percent of all commercial dry cleaning firms own a single facility. Table 5-4 reports the distribution of firms by number of dry-cleaning establishments owned, assuming that all 7,500 nonpayroll establishments (Radian, 1991a) are owned by single-facility firms. Even in the $500K to $1M firm receipts range, the average number of facilities per firm is below two. At the other extreme, 29 firms own about 22 facilities each.

The implication of this distribution are as follows. Up to a point, firm receipts grow because machine sizes increase and/or machine capacity utilization increases. Note that $75K-$100K firms have an average $93,829 of receipts accruing to their single facility, while <$25K firms have an average only $17,736 accruing to their single facility (Table 5-2). Since capital costs of control devices are similar for machines of all sizes and utilization rates, capital requirement impacts fall fairly proportionately as firm size increases—up to a point (see Section 7). After some point, receipts per

TABLE 5-4. NUMBER OF COMMERCIAL DRY CLEANING FACILITIES PER FIRM BY INCOME CATEGORY

Receipts Range ($000)	Facilities Per Firm
<25	1.00
25-50	1.00
50-75	1.00
75-100	1.00
100-250	1.03
250-500	1.18
500-1,000	1.64
1,000-2,500	2.90
2,500-5,000	7.07
>5,000	22.45

Source: 1987 Census of Service Industries, Subject Series (U.S. Department of Commerce, 1990b).

establishment stabilize at about $500,000 (see Table 5-2) and firms grow only by adding more facilities (see Table 5-3). Control economies of scale essentially cease to exist for firms larger than $1 million.

5.6 VERTICAL INTEGRATION AND DIVERSIFICATION

Vertical integration is a potentially important dimension in firm-level impacts analysis because a vertically integrated firm could be indirectly as well as directly affected by the NESHAP. For example, if a dry cleaning firm is vertically integrated in the manufacture and/or distribution of perchloroethylene (PCE), it could be indirectly and adversely affected by the NESHAP if demand for PCE diminishes after the regulation.

Ignoring for now that some dry cleaning facilities also engage in operations other than dry cleaning, a dry cleaning firm is considered vertically integrated if it also owns facilities that sell goods or services used as inputs by the dry cleaning industry and/or facilities that purchase dry cleaning services as inputs. Forward integration is unlikely because nearly all dry cleaning services are provided to individuals, not firms. Backward integration is unlikely because the main inputs in the dry cleaning industry are a building, dry cleaning machinery, energy, and PCE, all dissimilar to dry cleaning services.

Intra-firm diversification, sometimes referred to as horizontal integration, is a potentially important dimension in firm-level impact analysis for either or both of two reasons.

- First, a diversified firm could be indirectly as well as directly affected by the NESHAP. For example, if a dry cleaning firm is diversified in the manufacture of emissions control equipment (an unlikely scenario), it could be indirectly and favorably affected by the NESHAP.
- Secondly, a diversified dry cleaning firm may own facilities in unaffected industries like carpet cleaning, linen supply, power laundering, or shoe repair—a more realistic situation. This type of diversification would help mitigate the financial impacts of the NESHAP.

Intra-facility diversification is also a relevant consideration because dry cleaning facilities commonly engage in activities other than dry cleaning. Many dry cleaning facilities do alterations work, repair shoes, clean draperies, store garments, and sell other goods and services. This is another type of diversification that could mitigate the impact of the dry cleaning NESHAP on certain dry cleaning firms. Indeed, the prominence and magnitude of intra-facility diversification in the industrial dry cleaning industry is partly the reason for not including those firms at all in this financial impacts analysis.

5.7 FINANCIAL CHARACTERISTICS OF FIRMS IN REGULATED INDUSTRY(IES)

This section characterizes the financial condition of commercial dry cleaning firms. Clark (1989) investigated the suitability of available small business financial data bases for EPA's use in its economic analyses. He concludes that two main financial data bases are appropriate: Internal Revenue Service (IRS) data and Dun and Bradstreet (D&B) data. Although each of the data bases has its comparative merits, the Dun and Bradstreet data are better for characterizing the finances of dry cleaning firms. The D&B data are more recent than the IRS data, are available for the dry cleaning industry, and are probably based on a larger (though nonrandom) sample than the IRS data. The financial condition of dry cleaning firms can be characterized using Dun and Bradstreet's 1989-1990 Industry Norms and Key Business Ratios (Duns Analytical Services, 1990).

The D&B data base contains 991 commercial dry cleaning establishments. Clark (1989) notes that the financial information provided to D&B is supplied by the businesses to obtain favorable credit ratings; therefore, the businesses have an incentive to make their net worth and income look as good as possible. Companies that are not doing well financially have an incentive to keep their financial information out of D&B's data base. Thus the financial data reported therein are based on a possibly nonrepresentative sample of firms.

Industry Norms and Key Business Ratios unfortunately does not characterize the finances of firms by firm size. Consequently, informal assumptions are necessary to estimate the number of firms in each of the seven receipts ranges in below-average, average, and above-average financial condition. Two alternative assumptions are employed in this analysis.

One assumption (financial scenario I) reflects the high probability that firms in below-average financial condition are disproportionately small since the capacity utilization of their machines is so low. Dry cleaning machine capacity utilization at facilities with annual receipts under $25,000 is only about 7 percent, and that of facilities with annual receipts of $25,000 to $50,000 is only about 15 percent. Capacity utilization approaches 80 percent only when facility receipts approach $100,000.

Table 5-5 presents estimated numbers of firms by size and baseline financial condition assuming a positive relationship between the two. The result is that all 6,834 firms in below-average financial condition have annual receipts below $50,000, that all 13,664 firms in average financial condition have annual receipts between $25,000 and $250,000, and that all 6,834 firms in above-average financial condition have annual receipts above $100,000.

TABLE 5-5. NUMBER OF DRY CLEANING FIRMS, BY SIZE AND BASELINE FINANCIAL CONDITION

Receipts Range ($000)	Total	Baseline Financial Condition		
		Below Average	Average	Above Average
<25	6,690	6,690	0	0
25-50	4,187	144	4,043	0
50-75	2,581	0	2,581	0
75-100	2,581	0	2,581	0
100-250	6,823	0	4,459	2,364
250-500	2,870	0	0	2,870
>500	1,600	0	0	1,600
Total	27,332	6,834	13,664	6,834

Source: Table 5-2 and Duns Analytical Services (1990), Financial Scenario I.

Table 5-6 uses the D&B data to characterize the population and shows the number of dry cleaning firms in each of seven receipts categories and each of three financial conditions under an alternative assumption that there is no relationship between firm size and financial condition (financial scenario II). Fifty percent of all firms are, regardless of size, allotted in the "average financial condition" grouping, and 25 percent of all firms in each of the "below-average" and "above-average" financial condition groupings.

Dun and Bradstreet data are employed to derive financial profiles of dry cleaning firms in below-average, average, and above-average financial conditions. Income statements and balance statements are the two basic financial reports kept by firms. The former reports the results of a firm's operation during a period of time--usually one year in practice. The latter is a statement of the financial condition of the firm at a point in time--usually December 31 or the last day of the firm's fiscal year.

TABLE 5-6. NUMBER OF DRY CLEANING FIRMS, BY SIZE AND BASELINE FINANCIAL CONDITION

Receipts Range ($000)	Total	Baseline Financial Condition		
		Below Average	Average	Above Average
<25	6,690	1,673	3,344	1,673
25-50	4,187	1,047	2,093	1,047
50-75	2,581	645	1,291	645
75-100	2,581	645	1,291	645
100-250	6,823	1,706	3,411	1,706
250-500	2,870	718	1,434	718
>500	1,600	400	800	400
Total	27,332	6,834	13,664	6,834

Source: Table 5-2 and Duns Analytical Services (1990), Financial Scenario II.

The income statements and balance sheets of dry cleaning firms of different sizes and financial conditions are presented in Appendix A (Tables A-1 through A-3). The five sales categories are largely selected for cut-off analysis purposes. All other lines in the two statements derive, directly or indirectly, from "sales" relationships given in D&B. Several examples will clarify how the statements are derived.

An estimated 11,293 dry cleaning firms have receipts over $100,000. The estimated average receipts for these firms total $367,510, which is reported as "sales" in the income statement. D&B reports that the average dry cleaning firm in the data base has a net profit of 7 percent of sales. This ratio multiplied by the sales estimate of $367,510 yields the estimated "net profit" of $25,725 in the income statement. The three other lines in the income statement are analogously derived by applying D&B ratios multiplied by sales.

Balance sheet items are derived in an analogous manner. D&B reports that the average dry cleaning firm in the data base has about $480 of total assets for every $1,000 dollars of sales. This ratio multiplied by the sales estimate of $367,510 yields estimated total assets of $177,257. D&B reports that the average dry cleaning firm has about $369 of current assets, $373 of fixed assets, and $258 of other noncurrent assets per $1,000 of total assets. These ratios multiplied by the total assets estimate yield the estimates presented for those variables in the tables In the liabilities section of the balance sheet, "total liabilities and net worth" must equal "total assets," and the component parts are computed using D&B ratios multiplied by the total.

To project the potential financial impacts of the NESHAP on firms of different sizes in below-average financial condition, baseline financial profiles of representative less healthy firms are required. Unfortunately, Dun and Bradstreet does not rank businesses in a particular industry in their data base from "most healthy" to "least healthy" and then report the financial ratios of the firm that falls in the lower quartile of that distribution. Instead, D&B calculates each ratio of interest (e.g., current assets/current liabilities) for the 991 firms and then ranks these ratios from "best" to "worst." D&B then reports the lower quartile for each of these ratios individually. Consequently, constructing the financial statement of the lower quartile firm is not possible.

Constructing pro forma financial statements of a firm that yield financial ratios closely resembling the D&B lower quartile ratios is possible. Appendix A presents the income statements and balance sheets of dry cleaning firms in below-average financial condition. D&B reports that the lower quartile profit-to-sales ratio of commercial dry cleaning firms in its data base is about one percent, which is consistent with the income statement entries. Other lower-quartile ratios reported by D&B and employed in the construction of these pro forma statements include assets-to-sales of approximately 70 percent, fixed assets-to-net worth of approximately 155 percent, and a return on net worth of approximately 3.5 percent.

To project the potential financial impacts of the NESHAP on firms of different sizes in above-average financial condition, baseline financial profiles of representative healthy firms are required. For reasons described above, constructing the financial statements of the upper-quartile firm is not possible. Again, constructing pro forma financial statements of a firm that yield financial ratios closely resembling the D&B upper-quartile ratio is possible. Appendix A presents the income statements and balance sheets of dry cleaning firms in the same size categories, all in above-average financial condition.

5.8 KEY BUSINESS RATIOS OF DRY CLEANING FIRMS

Financial ratio analysis is a widely accepted way of summarizing the financial condition of a firm. Financial ratios include four fundamental types:

- indicators of liquidity,
- activity,
- leverage, and
- profitability.

The baseline financial status of dry cleaning firms is characterized below by means of financial ratio analysis.

Liquidity indicates the ability of the firm to meet its near-term financial obligations as they come due. A common measure of liquidity is the current ratio, which divides the firm's current assets by its current liabilities. Current assets include cash, accounts receivable, inventories, or other assets that represent or can be converted to cash within one year. Current liabilities are essentially bills that must be paid within the year (including current maturities of long-term debt). Higher ratios are generally more desirable than lower ratios, because they indicate greater liquidity or solvency.

Activity indicates how effectively the firm is using its resources. The ratio of firm sales to fixed assets (plant and equipment), the fixed asset turnover ratio, measures how well the firm uses its capital equipment to generate sales. Higher ratios are generally more desirable than lower ratios.

Leverage indicates the degree to which the firm's assets have been supplied by, and hence are owned by, creditors versus owners. Leverage should be in an acceptable range indicating that the firm is using enough debt financing to take advantage of the lower cost of debt, but not so much that current or potential creditors are uneasy about the ability of the firm to repay its debt. The debt ratio is a common measure of leverage that divides all debt, long and short term, by total assets.

Profitability measures the return, usually as net income after all costs, debt repayment, and taxes, to the firm over some time period, usually one year. Profitability is most commonly, though perhaps not most relevantly, expressed as a return to sales. Because net worth is a measure of the value of the firm to its owners, profitability-to-net worth is a measure of the annual return to owners expressed as a percent.

Financial ratio indicators of liquidity, activity, leverage, and profitability among dry cleaning firms in below-average, average, and above-average financial health are presented in Table 5-7. Clearly, as financial status improves, firms become more liquid. Note particularly that below-average firms are only marginally able, at best, to meet current obligations with their cash and other current assets.

Also as expected, firms in better financial health generate more sales with their plant and equipment. In the context of the dry cleaning industry, this condition may indicate that firms with higher machine capacity utilization are more financially sound than those with lower machine capacity utilization. Sales per dollar of fixed assets are more than twice as high among firms in average financial condition than among those in below-average financial condition. This lends support to financial scenario I of a positive relationship between firm size and financial health, that in turn underlies the estimates presented in Table 5-5.

Leverage analysis of dry cleaning firms in the three different financial states is more difficult than liquidity, activity, or profitability analysis. The "mean firm" in the D&B data base is about 46 percent debt financed (and 54 percent equity financed). As explained above, less debt is not necessarily "better" because a firm using too little debt is not minimizing its cost of capital. From a creditor's point of view though, less debt is probably better than more debt, on balance. D&B reports are creditor-oriented, which probably explains why in D&B's judgment a low debt ratio is desirable. Because a main

TABLE 5-7. BASELINE FINANCIAL RATIOS OF DRY CLEANING FIRMS

	Financial Condition		
	Below Average	Average	Above Average
Liquidity			
Current ratio (times)	0.80	1.73	5.10
Activity			
Fixed asset turnover ratio (times)	2.30	5.56	7.54
Leverage			
Debt ratio (percent)	60.00	45.90	15.00
Profitability			
profit to sales (percent)	1.00	7.00	13.00
profit to assets (percent)	1.40	14.50	32.50
profit to NW (percent)	3.60	26.80	38.20

Source: Duns Analytical Services, 1990.

objective of this analysis is to evaluate a dry cleaning firm's ability to obtain and its cost of obtaining credit to purchase control equipment, this interpretation is satisfactory.

Profitability analysis is useful because it helps evaluate both the incentive and the ability of dry cleaning firms to incur equipment and operating costs required for compliance.[1] More profitable firms have more incentive than less profitable firms to comply because the annual returns to doing business are greater. In the extreme, a single-facility firm earning zero profit (price equals average variable cost) has no incentive to comply with a regulation imposing any positive cost unless it can pass along the

[1]Dry cleaning firms that are either unwilling or unable to comply with the NESHAP must sell the facility, switch solvents, or discontinue their dry cleaning operations at the noncompliant facility.

entire cost of the regulation to its customers. This same firm is also less able to comply because it is less able to obtain a loan.

The relationship between profitability and firm health is clearly demonstrated in Table 5-7. One-quarter of the dry cleaning firms in D&B's data base are only marginally profitable by all three measures. If some or all of the estimated 6,690 commercial dry cleaning firms with annual receipts under $25,000 are among the lower quartile in profitability, they are generating annual profits of only several hundred dollars. Average dry cleaning firms are seven times more profitable (related to sales) than below-average firms, and above-average firms are about twice as profitable as average firms.

These financial ratios suggest that the NESHAP requirements may have a disproportionate impact on small firms and firms in below-average financial health. The financial ratios of below-average firms are sometimes substantially worse than those of average firms. These baseline ratios will be used as a basis of comparison in Section 7 when the potential financial impacts of the NESHAP on dry cleaning firms are considered.

5.9 AVAILABILITY AND COSTS OF CAPITAL

Without exception, affected dry cleaning facilities would have to purchase control equipment to meet the regulatory alternatives or discontinue dry cleaning operations ("closure"). In addition, many affected facilities would incur recurring operating and maintenance costs that exceed their solvent recovery credits. The availability and costs of capital to dry cleaning firms of different sizes, types, and financial conditions will influence the financial impacts of the dry cleaning NESHAP.

Hastsopoulos (1991) clearly states that in making investments, companies use two sources of funds: equity and debt. Each source differs in its exposure to risk, in its taxation, and its cost. Equity financing involves obtaining additional funds from owners: proprietors, partners, or shareholders. Partners and shareholders, in turn, can be existing owners or new owners. Obtaining new capital from existing owners can be further dichotomized into internal and external financing. Using a firm's retained earnings is equivalent to internal equity financing. Obtaining additional capital from the proprietor, one or more existing partners, or existing shareholders constitutes external equity financing.

Debt financing involves obtaining additional funds from lenders who are not owners; they include buyers of bonds, banks, or other lending institutions. Debt borrowing involves a contractual obligation to repay the principal and interest on an agreed-upon schedule. Failure by the firm to meet the obligation can result in legal bankruptcy.

The dry cleaning industry is dominated by small firms for whom selling stocks and bonds is not a very realistic option. Steinhoff and Burgess (1989) list a large number of sources of funding for small businesses, but most fit a description of either debt or equity reasonably well:

- personal funds and/or retained earnings,
- loans from relatives and friends,
- trade credit,
- loans or credit from equipment sellers,
- mortgage loans,
- commercial bank loans,
- Small Business Administration loans,
- small business investment company loans,
- government sponsored business development companies,
- partners,
- venture capital funding, and
- miscellaneous sources.

Using personal funds and/or retained earnings, obtaining loans from relatives and friends, obtaining funds from partners, and obtaining venture capital funding effectively constitute equity financing because they generally do not involve a legal contract for repayment. This type of borrowing is considered more risky for the lender than for the borrowing firm because in the event of bankruptcy, the lenders have claim to the dissolved assets of the firm only after those of debt lenders.

Trade credit, loans or credit from equipment sellers, mortgage loans, commercial bank loans, Small Business Administration loans, small business investment company loans, and government-sponsored business development company loans generally constitute debt financing because they involve contractual promises to repay the principal and some agreed-to interest. In the event of firm bankruptcy, which can be initiated by a lender whose loan terms are not being honored by the firm, debt lenders are paid out of the assets of the firm before equity lenders. Thus, debt borrowing is considered more risky for the firm's owners than equity borrowing.

One important difference then between debt and equity financing is its cost. The expected or anticipated rate of return required by equity lenders is higher than the required rate of return to debt lenders because of the relative riskiness of equity. A second important difference between the two sources of funds is tax related. Interest payments on debt are deductible to the firm as a cost of doing business for state and federal income tax purposes. Returns to owners are not tax deductible. Thus, borrowing debt has a distinct tax-related cost advantage. For two reasons, then, the cost of debt is normally lower than the cost of equity.

In this analysis, a simplifying assumption is made that dry cleaning firms have two possible sources of capital: bank loans (debt) and retained earnings (equity). The availability and cost of capital is evaluated in that context.

A firm's cost of capital is a weighted average of its cost of equity and after-tax cost of debt:

$$WACC = W_d \cdot (1-t) \cdot K_d + W_e \cdot K_e, \tag{5.1}$$

where

WACC = weighted average cost of capital

W_d = weighting factor on debt

t = marginal effective state and federal corporation/individual tax rate

K_d = the cost of debt or interest rate

W_e = weighting factor on equity

K_e = cost (required rate of return) of equity.

A real (inflation-adjusted) cost of capital is desired, so employing the GNP implicit price deflator for the seven year period 1982-1989 adjusts nominal rates to real rates. Using an adjustment factor of 4 percent assumes that the inflation premium on real rates for the next seven years is the actual rate of inflation averaged over the last seven years (1990 Economic Report of the President).

Based on conversations with a business loan officer at a large commercial bank (Bass, 1991), seven-year prime-plus variable interest rate bank loans for control equipment are assumed to be available to qualifying firms on the following cost terms:

- best applicants: prime plus one-half percent
- typical health applicants: prime plus one percent
- below-average but still-sound applicants: prime plus 2 percent

According to Bass, actual loan terms are negotiated on a case-by-case basis, but the guidelines given above are reasonable. Particularly germane to this analysis is his insistence that bank loans are not made to firms at any cost unless expectations are high that they well be repaid according to the terms of the loan. This is why the risk premium spread from one-half percent to 2 percent is so narrow.

Between 1982 and 1989 the prime rate varied around a mean of approximately 10.5 percent, nominal. Using the inflation premium discussed above, and assuming that the nominal prime rate will average about 10.5 percent over the next seven years, the expected real prime rate is about 6.5 percent. Then following Bass's guidelines for loan risk premium, the following real before-tax debt costs are computed and employed:

- best applicants: 7 percent
- typical health applicants: 7.5 percent

• below-average but still-sound applicants: 8.5 percent

Because debt interest is deductible for state and federal income tax purposes, the cost of debt has to be adjusted downward. An approximate effective marginal state and federal tax rate of 38 percent is computed using data from The Tax Foundation (1991). Applying this rate to the real costs of debt computed earlier derives after-tax real debt costs for dry cleaning firms in three different financial conditions:

- above-average financial condition: 4.3 percent
- average financial condition: 4.7 percent
- below-average financial condition: 5.3 percent

The cost of equity, K_e, can be estimated by adding an equity risk premium to a risk-free required rate of return (Jones, 1991). Using the 1982-1989 average return on 10-year federal treasury securities as the risk-free rate, and assuming it is applicable for the next seven years, a nominal risk-free rate of 10 percent is obtained.

Jones (1991) reports that common practice is to use the Standard and Poor 500 long-run average equity risk premium of about 8 percent as a first basis for computing the cost of equity in conjunction with the risk-free rate. Thus, the S&P 500 nominal equity yield is about 18 percent, which is an estimate of the average cost of equity for all publicly traded stocks (Van Horne, 1980).

Jones indicates that still another risk premium has to be added for firms that are more risky than the S&P 500 average, and that dry cleaning firms probably generally fall in this category. Even though the assumption is necessarily arbitrary, dry cleaning firm equity risk premiums are employed as follows:

- dry cleaning firms in above-average health: 0 percent
- dry cleaning firms in average health: 2 percent
- dry cleaning firms in below-average health: 6 percent.

Adding these dry cleaning firm equity risk premiums and simultaneously subtracting inflation premiums result in the following set of real equity costs for dry cleaning firms of different financial states:

- above-average financial condition: 14 percent
- average financial condition: 16 percent
- below-average financial condition: 20 percent

These estimates appear reasonable in view of a study by Anderson, Mims, and Ross (1987) which estimated real equity costs of 11 percent, 14 percent, and 19 percent for firms with Moody Bond Ratings of AAA (the highest rating), BBB, and BB, respectively.

Weighting the debt and equity cost components is difficult for several reasons. First, market value weights are more theoretically correct than book value weights, but only the latter are observable for privately owned dry cleaning firms (Bowlin, Martin, and Scott, 1990). Second, target weights, not historical weights, are appropriately used for estimating the cost of capital (Bowlin, Martin, and Scott, 1990). Again, only historical weights are observable. Third, marginal costs of capital, not historical average costs, are appropriate hurdle rates for new investments (Bowlin, Martin, and Scott, 1990).

For this analysis, the industry average debt/equity structure is the optimal/target structure for all dry cleaning firms and book-value weights approximate market-value weights (Bowlin, Martin and Scott, 1990). The debt and equity weights of the mean dry cleaning firm in the Dun and Bradstreet data base are 31 percent and 69 percent, respectively. Using these weights and the component costs of capital derived above gives the weighted average costs of capital for dry cleaning firms in the three financial states:

- above-average financial condition: 11 percent
- average financial condition: 12.5 percent
- below-average financial condition: 15.4 percent

These cost of capital estimates are not presented as actual costs to particular firms. Likewise, they are not meant to imply that firms within a financial condition category all have the same cost of capital, or that borrowed funds will necessarily be available to all firms. In particular, recognize that 25 percent of all firms are in "below-average financial condition." Within this range, some firms will be far more financially distressed than others. The 15.4 percent real rate may overestimate the cost of capital for some of these dry cleaning firms and underestimate some unusually distressed firms.

Adequate control capital funds are probably unavailable through normal channels to small, particularly distressed firms. Bass (1991) indicates that most commercial banks will not lend money to financially distressed firms, and retained earnings at small, distressed firms may be inadequate to pay for control capital. Bass also stated that his institution, and others, won't lend money to dry cleaning firms without first conducting an "environmental audit" to protect the bank in the event that environmental contamination is present or foreseeable at the time of the loan. One can never discount the possibility that funds would be available from owners' personal funds, new partners, friends, relatives, or other sources.

SECTION 6

RESPONSES TO THE REGULATORY ALTERNATIVES

The regulatory alternatives considered for proposal require dry cleaning facilities to install and operate vent control devices. Affected entities will incur initial and recurring costs as a result of these requirements. This section presents an overview of the requirements of the candidate regulatory alternatives and a description of the potential firm-level and facility-level responses to these requirements.

6.1 OVERVIEW OF REGULATORY ALTERNATIVES

Three regulatory alternatives are evaluated here. The main difference in the control requirements among the alternatives is the treatment of existing control mechanisms on transfer machines. Table 6-1 summarizes the control equipment options for each of the regulatory alternatives by industry sector and machine technology.

Dry cleaning machines emit PCE from two sources: vent emissions and fugitive emissions. Fugitive emissions are controlled under each alternative by requiring good work practices. The percentage reduction in fugitive emissions attributable to good work practices is not quantified for this analysis. Vent emissions are controlled under each alternative by air pollution control devices. Control equipment required under Regulatory Alternative I reduces vent emissions from dry-to-dry and transfer machines by 95 and 85 percent, respectively, compared to uncontrolled levels. For machines in the commercial sector, Alternative I mandates using a carbon adsorber (CA) or a refrigerated condenser (RC). Because of technical constraints, all other machines must use a CA. The control equipment required under Regulatory Alternative II reduces vent PCE emissions from dry-to-dry and uncontrolled transfer machines by 95 percent (compared to uncontrolled levels). Transfer machines with an RC in place are not required to purchase additional equipment under this alternative. Finally, control equipment required under Regulatory Alternative III also results in a 95 percent reduction in vent PCE emissions (compared to uncontrolled levels).

TABLE 6-1. CONTROL TECHNOLOGY OPTIONS UNDER EACH REGULATORY ALTERNATIVE

Industry Sector and Machine Type	Regulatory Alternative I	II	III
Coin-Operated			
dry-to-dry	CA	CA	CA
Commercial			
dry-to-dry	CA RC	CA RC	CA RC
transfer (uncontrolled)	CA RC	CA	CA
transfer (RC controlled)	no additional control required	no additional control required	CA
Industrial			
dry-to-dry	CA	CA	CA
transfer	CA	CA	CA

CA = Carbon Adsorber
RC = Refrigerated Condenser
Source: Radian, 1990a.

Alternative III differs from Alternative II because it requires CA's on transfer machines currently controlled with an RC.

Current owners of dry cleaning facilities with non-compliant machines must decide to comply or exit the industry. That decisionmaking process at the firm level is described in Section 6.2. Facility-level responses are discussed in Section 6.3

6.2 FIRM-LEVEL RESPONSES

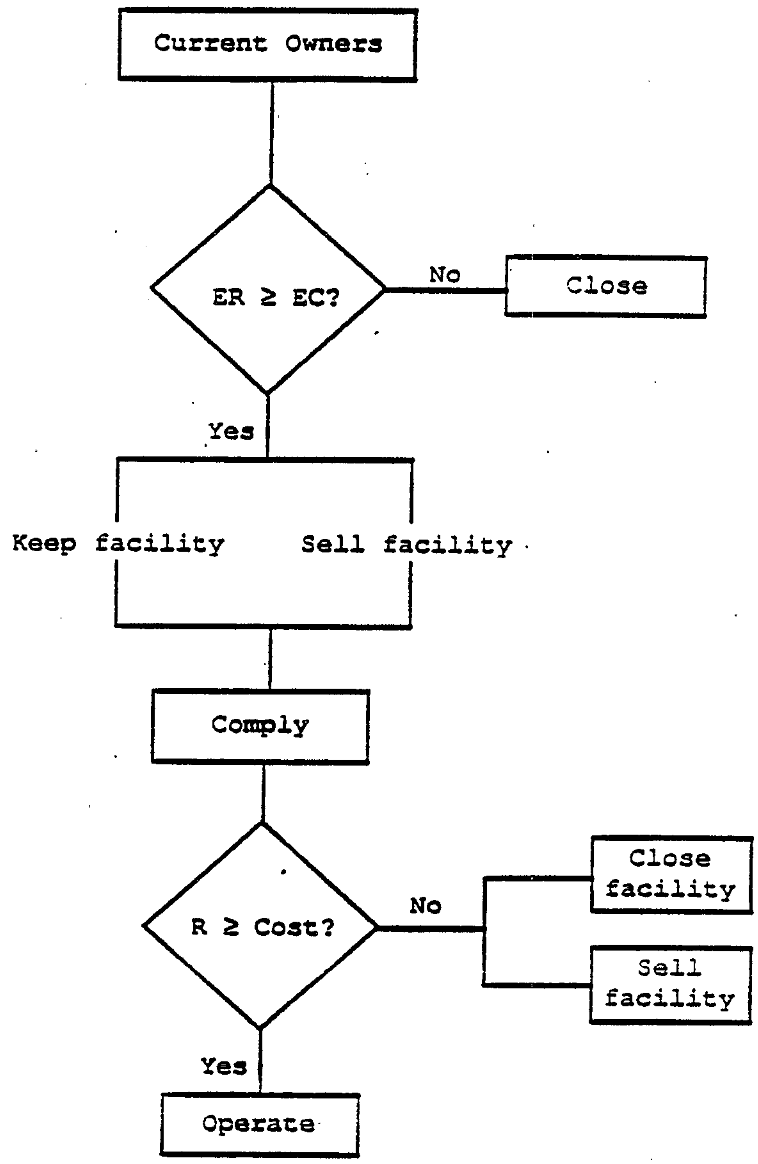
The dry cleaning NESHAP will potentially affect firms that own dry cleaning facilities not in compliance with the regulatory alternatives considered. A firm is a legal organization consisting of one domestic establishment or more under common ownership or control. An establishment is a single physical location at which business is conducted--a site of land with plant and equipment that combine inputs like materials, energy, and labor to produce outputs, like dry cleaning services. Firms are legal business entities that, in this context, own one or more facilities.

The owners of dry cleaning firms that own dry cleaning facilities potentially affected by the regulatory alternatives have several ways they can respond. The more important of these possible responses are depicted in Figure 6-1.[1]

The current owners of dry cleaning firms operate dry cleaning facilities whose periodic (e.g., annual) revenues cover or exceed their periodic average variable costs. The owners of dry cleaning facilities that do not have the vent controls required under the candidate regulatory alternatives must assess whether controlled facilities will continue to meet this same operating criterion. These owners must evaluate their alternatives, assess the benefits and costs of each, and respond in some manner. Owners generally respond in the way that maximizes the net-present value of the firm.

The assessment of post-compliance costs and revenues is depicted in Figure 6-1. The expected revenues (ER) of the complying facility are approximately the product of the expected price and the expected quantity. The expected costs (EC) are functionally related to the facility's current variable costs plus costs of compliance. Compliance costs, in turn, include the costs of purchasing, installing and operating control equipment, the costs of financing the capital investment, less any solvent recovery credits.

[1]Technically, substituting other solvents for PCE is also an option. However, that choice is not addressed because of the higher operating costs associated with those solvents.



E = expected

R = periodic revenues (Price x Quantity)

C = periodic costs (variable cost plus periodic repayment of principal and return on investment)

Figure 6-1. Responses to the Proposed Regulation

If the expected costs of operating the complying facility exceed the expected revenues, the owner of the facility closes it. Altman (1983) defines "economic failure" as the inability of invested capital to continually cover its variable costs through revenues. For purposes of this discussion, owners of dry cleaning firms are assumed to close facilities if they project that annual revenues will be below annual variable costs. Furthermore, it is assumed that once closed, facilities do not re-open.

If the expected revenues of operating the complying facility exceed the expected costs, it is economically viable and the owners will likely keep the facility or sell it. For this discussion, owners keep the facility if they have and/or can borrow the funds required for the capital investment. If, however, they neither have nor can borrow the required funds, they may decide to sell the facility.

If the compliant facility is expected to remain profitable, it is assumed that the current or new owners of the facility will comply with the regulation in the manner that maximizes the net-present value of the firm. In most circumstances, this is equivalent to responding in the least (net-present) cost manner. If realized post-compliance revenues cover or exceed realized costs, it is assumed that the firm continues to operate the facility. If realized revenues are inadequate to cover realized costs, the owners will likely close or sell the facility. If costs exceed revenues for economic reasons, the owners will likely close the facility. These reasons might include operating costs that exceed projections, revenues that fall short of projections, or both. If costs exceed revenues for financial reasons, the owners may sell the facility. This could occur, for example, if the interest rate (and required payments) on a variable rate loan rose to where revenues were insufficient to cover the under-projected finance charges.

Because a viable dry cleaning firm can own viable facilities along with non-viable ones—and other profitable non-dry cleaning assets as well—a regulation that closes one or more dry cleaning facilities may leave the company that owns it (them) virtually unaffected. Alternatively, because viable facilities can be owned by non-viable (e.g., debt laden) companies, a regulation that would leave a facility viable after compliance may nonetheless force a firm to sell the facility.

6.3 FACILITY-LEVEL RESPONSES

The facility with an uncontrolled PCE machine must either comply with the regulation, switch solvents, or cease operations. As discussed in Section 2, solvent substitution is unlikely. The following subsections address the compliance options for facilities under each regulatory alternative. Subsection 6.3.1 outlines the methods and assumptions used to compute the costs (net present) associated with each compliance option and subsection 6.3.2 identifies the options that satisfy the requirements of each regulatory alternative by industry sector and machine type.

6.3.1 Compliance Option Costs

Three types of compliance options will satisfy the requirements of the regulatory alternatives:

- retrofit with a CA
- retrofit with an RC
- accelerated purchase of a new dry-to-dry machine with a built-in vent control

The choice that the facility owner makes depends on the sector, the machine type, baseline vent controls, and its individual financial situation. For the purposes of this analysis, it is assumed that the owner will choose the least cost option that satisfies the requirements of the regulation.

To identify the lowest cost option, the incremental capital and operating cost associated with each option is estimated. These costs vary by machine type, capacity utilization, and the age of the machine. The net present cost (NPC) of each available option is then computed. The following methods are used to compute the NPC of each control option:

Control Option 1: Carbon Adsorber

$$NPC_{CA} = K_{CA} + \sum_{t=0}^{n-1} \left[O_{CA} / (1 + r)^{t} \right] \qquad (6.1)$$

Control Option 2: Refrigerated Condenser

$$NPC_{RC} = K_{RC} + \sum_{t=0}^{n-1} \left[O_{RC} / (1 + r)^t \right] \quad \text{if } n < 7 \tag{6.2}$$

or

$$NPC_{RC} = K_{RC} + \sum_{t=0}^{n-1} \left[O_{RC} / (1 + r)^t \right] + [(K_{RC} / (1 + r)^7)] \quad \text{if } n > 7$$

Control Option 3: Accelerated Purchase of New Dry-to-Dry Machine

$$NPC_{DD} = K_{DD} + \sum_{t=0}^{14} \left[O_{RC} / (1 + r)^t \right] - \left\{ \left[K_{DD} / (1 + r)^n \right] + \sum_{t=n}^{14} \left[O_{RC} / (1 + r)^t \right] \right\} \tag{6.3}$$

where

NPC_{CA} = the net present cost of a CA

NPC_{RC} = the net present cost of an RC

NPC_{DD} = the net present cost of accelerating the purchase of a new dry-to-dry machine

K_{CA} = the capital cost of a CA

K_{RC} = the capital cost of an RC

K_{DD} = the capital cost of a new dry-to-dry machine

O_{CA} = the incremental operating cost of a CA

O_{RC} = the incremental operating cost of an RC net of solvent recovery

r = the weighted average cost of capital[2]

n = the remaining life of the existing machine (cannot exceed 15)

t = the year (1991 is year 0)

Control option 3 represents the incremental cost associated with the accelerated purchase of a new dry-to-dry machine. Facility owners replace

[2]This cost of capital differs by firm financial status. The discount factor estimated for this analysis is 11 percent for firms in good financial condition, 12.5 percent for firms in average condition, and 15.4 percent for firms in poor condition. For a more complete discussion, see Section 5.

existing machines with new dry-to-dry machines equipped with built-in vent controls even in baseline. Therefore, only the additional cost associated with accelerating the purchase of a new dry-to-dry machine is included in the cost calculations. Owners of transfer equipment that decide to accelerate the purchase of a new dry-to-dry machine would incur lower baseline operating costs because of greater solvent recovery associated with dry-to-dry machines. This cost savings is not included in the net present cost calculations described above. If a credit for reduced baseline operating costs were included in the calculations, a slightly larger share of the facilities would be projected to choose option 3 as the least-cost compliance option. Because these operating cost credits are not included, the annualized compliance costs computed in Section 7 may be slightly overestimated.

In computing these costs, several assumptions are made:

- The distribution of the remaining life of existing machines is rectangular. Dry-to-dry machines have a 15-year life; transfer machines have a 20-year life.

- Virtually no new transfer machines have been sold in the last five years. Therefore, one-fifteenth of the total population of machines retires each year.

- In the absence of regulation, all machines would have been replaced by new dry-to-dry machines with built-in vent controls. The current stock of uncontrolled machines would have been completely replaced by these controlled machines within 15 years.

- Costs are computed for a 15-year period of analysis.[3]

- Facility owners evaluate the cost of the control options using a real, after-tax weighted average cost of capital (WACC), which differs depending on their financial status. (See Section 5 for a discussion of the method for computing the WACC.)

- The facility financial status, the WACC, and the share of facilities in each financial status are given below:

[3]The mathematics of the cost formula require the notation of years 0-14, where year 0 is the first year.

Status	WACC	Share of Facilities
poor	15.4%	25%
average	12.5%	50%
good	11.0%	25%

- Operating costs are incurred at the beginning of each period. The costs of control option 3 include the RC's operating costs because most new dry-to-dry machines with vent controls use RC technology.

- Control devices purchased for existing machines in the commercial and industrial sectors are used only for the remaining life of the existing machines or the remaining life of the control device, whichever is shorter. Because new machines for these sectors come equipped with built-in vent controls, the control device will not be transferred to the new machine.

- Control devices purchased for existing machines in the coin-operated sector are transferred to replacement machines. In general, new dry-to-dry cleaning machines in this sector are not equipped with built-in controls.

- Under option 2, machines with more than seven years of remaining life must purchase an RC device in the first year and the eighth year. (These devices have a seven-year life.) Facilities with seven or fewer years remaining life will purchase only one RC.

As indicated in Table 6-1, the regulatory alternative dictates the compliance options that owners may consider. These options vary by machine type and industry sector. Subsection 6.3.2 below identifies the options that will satisfy the requirements of each regulatory alternative.

6.3.2 Compliance Options Under Each Regulatory Alternative

Under each of the regulatory alternatives, the owner of a coin-operated facility has only one choice; a CA must be retrofitted to the machine. Refrigerated condensers are not made for the size of the machines used in this sector. Here the remaining life of the existing machinery is irrelevant. The coin-operated facility will purchase a CA for its existing machines and transfer the control device to replacement machines. The 'n' term shown in Equation (6.1) is always 15 in this sector.

The facility owner in the commercial sector has three control options under Alternative I. These options are the same for either a dry-to-dry machine or a transfer machine. The first option is the installation of the

CA. The cost computation is similar to that described above for the coin-operated sector (see Equation (6.1)). The only difference is that the age of existing equipment does matter. After the existing equipment wears out, it is assumed that the facility owner will purchase a new dry-to-dry machine with an internal vent control device. Because the purchase would occur in the absence of regulation, the net present cost of the CA is calculated for only the remaining years of life for the present machinery.

The second option available to the owner of a commercial facility is an RC, whose NPC is described in Equation (6.2). Again, the NPC of the RC is computed only for the remaining life of the dry cleaning machine.

The final option under this alternative is accelerating the purchase of a new dry-to-dry machine with an internal control device. Even in the absence of the regulation, the facility owner would probably have purchased a new dry-to-dry machine with a built-in vent control device when his existing machine required replacement. Therefore, the cost of the accelerated purchase only includes costs associated with those years before the expiration of the current machinery. Accordingly, the computation is seen in Equation (6.3). Of these three options described above, facilities will select the least cost option. Those facilities with older existing equipment are more likely to choose option 3 than facilities with a longer remaining life. This selection occurs because the incremental cost of accelerating the purchase of a new dry cleaning machine is lower for these facilities. It is projected that facility owners who choose to retrofit their existing equipment rather than to accelerate the purchase of a new machine will choose option 2 because of the lower NPC associated with this option.

For Regulatory Alternative II, the choices depend on machine type. For dry-to-dry machines, the choices are the same as outlined above, and the cost computations are outlined in Equations (6.1), (6.2), and (6.3). For owners of uncontrolled transfer machines, the selection is narrowed to the CA or the accelerated purchase of a new machine (Equations [6.1] and [6.2]). Owners of RC-controlled transfers, however, would be allowed to continue to use their RC with no additional control equipment required.

For Alternative III, the owner of facilities with dry-to-dry machines may choose between options 1, 2, and 3 (Equations [6.1], [6.2], and [6.3]). For transfer machines, the facility can choose only between the CA and the accelerated purchase (Equations [6.1] and [6.2]). Under this alternative, owners of RC-controlled transfer machines or uncontrolled transfer machines must retrofit with a CA or purchase a new dry-to-dry machine with a built-in vent control.

In the industrial sector, the choices are the same regardless of machine type and regulatory alternative. Facilities may choose between the CA or accelerating the purchase of a new machine (Equations [6.1] and [6.3]). The RC is not an option under any alternative because they are not made for these larger machines.

SECTION 7

IMPACTS OF THE REGULATORY ALTERNATIVES

Impacts of the regulatory alternatives are measured using an integrated approach that considers both economic and financial impacts. A methodological and empirical approach based on the principles of applied welfare economics is used to compute the economic impacts of the alternatives. Economic impacts are quantified through estimated market adjustments of price and output and corresponding effects on consumer and producer welfare. In addition, ownership impacts are estimated using financial data on the distribution of firm viability. Changes in firm financial status and capital availability for firms of different sizes and financial condition are estimated in the financial analysis.

The approach is integrated by using inputs from each type of analysis to compute impacts in the other. For example, financial impacts are based on the costs computed in the economic analysis. In turn, economic impacts are based on the costs of capital computed using data on the financial status of firms in the industry.

7.1 AFFECTED POPULATION

The population, as defined here, includes only facilities with dry cleaning equipment. Accordingly, coin-operated and industrial facilities without dry cleaning machines are not included. Similarly, commercial drop stations are not included.

Certain portions of the population would be unaffected under the alternatives considered for three reasons.

- The facility uses a solvent other than PCE. This distinction has the biggest impact in the industrial sector.
- The facility already has the required control equipment in place.
- The facility is exempt because of a size cutoff based on PCE consumption.

Thus, the affected population will vary with the regulatory alternatives and the different cutoff levels.

The four size cutoffs are based on PCE consumption levels that correspond to target levels of annual receipts (from dry cleaning activities only), shown in Table 7-1. If adopted, these size cutoffs would result in certain facilities being excluded from the regulation. Notice the differences between the dry-to-dry machines and the transfer machines. For the same level of annual receipts, the transfer machines consume more PCE than the corresponding dry-to-dry machines. This difference occurs because transfer machines have higher fugitive emissions, resulting in more solvent required to clean a given quantity of clothes (or to generate a given amount of receipts).

The population affected by the proposed regulatory alternatives can be measured in two ways. The first is the number of facilities. Table 7-2 shows the distribution of affected facilities by sector, model market, and cutoff level under Regulatory Alternatives I and II. Table 7-3 shows the distribution of affected facilities under Regulatory Alternative III. Facilities with RC-controlled transfer machines are affected under Regulatory Alternative III and unaffected under Regulatory Alternatives I and II.

Another method used to measure the share of the population potentially affected under each alternative is based on the output of clothes cleaned per year. Table 7-4 shows the distribution of affected output under Regulatory Alternatives I and II. The distribution of affected output under Regulatory Alternative III is reported in Table 7-5. The share of the population that is affected differs, particularly in the commercial sector, depending on how the population is measured. Under Regulatory Alternative II with no size cutoff, 34 percent of commercial facilities are affected. These facilities represent 26 percent of total commercial output. This trend results from the prevalence of baseline controls for large plants in this sector.

As noted in Section 6, all of the regulatory alternatives have the same requirements and produce the same response in the coin-operated sector. Therefore, no differences exist in the affected population under the three alternatives. Furthermore, if cutoff levels 2, 3, or 4 are implemented as part of the regulation, none of the coin-operated establishments will be affected. It should be noted that while many coin-operated establishments receive more than $50,000 in annual receipts, it is estimated that no facilities receive more than this amount from dry cleaning activities alone.

TABLE 7-1. SIZE CUTOFF LEVELS BASED ON CONSUMPTION OF PERCHLOROETHYLENE (PCE)

Size Cutoff	Annual Receipts from Dry Cleaning Activities[a] ($/yr)	Consumption of PCE by Machine Technology[b] (kg/yr)	
		Dry-to-Dry	Transfer
None	N/A	0	0
1	25,000	300	400
2	50,000	600	800
3	75,000	900	1,200
4	100,000	1,200	1,600

[a]Annual receipts are computed using a base price of $1.65 per kg of clothes cleaned for the coin-operated (self-service) sector, $6.34 per kg for the coin-operated (plant-operated) and commercial sectors, and $2.00 per kg for the industrial sector. These values refer to receipts from dry cleaning activities only.

[b]The consumption factor for dry-to-dry machines is 0.081 kg PCE per kg of clothes cleaned. The consumption factor for transfer machines is 0.115 kg PCE per kg clothes cleaned (Radian, 1990b).

Source: Radian, 1991c.

TABLE 7-2. DISTRIBUTION OF AFFECTED FACILITIES BY INDUSTRY SECTOR, MODEL MARKET, AND SIZE CUTOFF: REGULATORY ALTERNATIVES I AND II[a]

Industry Sector and Model Market	Total Number of Facilities	Number Affected Facilities by Size Cutoff				
		None	1	2	3	4
Coin-Operated[b]						
Self-Service	213	200	49	0	0	0
Plant-Operated	2,831	1,415	0	0	0	0
Total	3,044	1,615	49	0	0	0
Commercial[c]						
Market A	1,543	0	0	0	0	0
Market B	1,606	1,606	0	0	0	0
Market C	1,157	0	0	0	0	0
Market D	10,432	287	214	146	115	88
Market E	8,073	4,038	3,000	2,055	1,621	1,250
Market F	7,683	4,298	3,193	2,187	1,725	1,330
Total	30,494	10,229	6,407	4,388	3,461	2,668
Industrial[d]	325	65	65	65	65	65

[a]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

[b]The number of affected facilities under each size cutoff is based on the share of facilities at each income level (see Table 2-13), the average annual output at each income level (see Table 2-7), and solvent consumption factors (Radian, 1990b).

[c]The number of affected facilities under each size cutoff is based on the total number of potentially affected facilities in each Model Market (see Table 4-4), the share of facilities at each income level (see Table 2-13), the average annual output at each income level (see Table 2-4), and solvent consumption factors (Radian, 1990b).

[d]See Table 2-13.

TABLE 7-3. DISTRIBUTION OF AFFECTED FACILITIES BY INDUSTRY SECTOR, MODEL MARKET, AND SIZE CUTOFF: REGULATORY ALTERNATIVE III[a]

Industry Sector and Model Market	Total Number of Facilities	Number Affected Facilities by Size Cutoff: None	1	2	3	4
Coin-Operated[b]						
Self-Service	213	200	49	0	0	0
Plant-Operated	2,831	1,415	0	0	0	0
Total	3,044	1,615	49	0	0	0
Commercial[c]						
Market A	1,445	0	0	0	0	0
Market B	1,704	1,704	0	0	0	0
Market C	1,045	0	0	0	0	0
Market D	10,547	1,394	1,187	978	819	637
Market E	8,074	4,431	3,379	2,373	1,890	1,459
Market F	7,679	4,630	3,521	2,462	1,958	1,512
Total	30,494	12,159	8,087	5,813	4,667	3,608
Industrial[d]	325	65	65	65	65	65

[a]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

[b]The number of affected facilities under each size cutoff is based on the share of facilities at each income level (see Table 2-13), the average annual output at each income level (see Table 2-7), and solvent consumption factors (Radian, 1990b).

[c]The number of affected facilities under each size cutoff is based on the total number of potentially affected facilities in each Model Market (see Table 4-4), the share of facilities at each income level (see Table 2-13), the average annual output at each income level (see Table 2-4), and solvent consumption factors (Radian, 1990b).

[d]See Table 2-13.

Source: Radian, 1991c.

TABLE 7-4. DISTRIBUTION OF AFFECTED OUTPUT BY INDUSTRY SECTOR, MODEL MARKET, AND SIZE CUTOFF: REGULATORY ALTERNATIVES I AND II[a]

Industry Sector and Model Market	Total Output (Mg/yr)	Total Affected Output by Size Cutoff (Mg/yr)[b]				
		None	1	2	3	4
Coin-Operated						
Self-Service	577	535	220	0	0	0
Plant-Operated	3,891	985	0	0	0	0
Total	4,468	1,520	220	0	0	0
Commercial						
Market A	13,222	0	0	0	0	0
Market B	3,819	3,819	0	0	0	0
Market C	25,476	0	0	0	0	0
Market D	227,709	4,750	4,576	4,206	3,928	3,588
Market E	155,823	67,141	64,673	59,536	55,636	50,969
Market F	145,898	71,447	68,820	63,351	59,200	54,231
Total	571,949	147,157	138,068	127,093	118,764	108,788
Industrial	170,902	34,180	34,180	34,180	34,180	34,180

[a]Total output and affected output values computed using average output values reported in Tables 2-5 and 2-7, the distribution of facilities in Table 2-13, and the distribution of affected facilities in Table 7-2.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

TABLE 7-5. DISTRIBUTION OF AFFECTED OUTPUT BY INDUSTRY SECTOR, MODEL MARKET, AND SIZE CUTOFF: REGULATORY ALTERNATIVE III[a]

Industry Sector and Model Market	Total Output (Mg/yr)	Total Affected Output by Size Cutoff (Mg/yr)[b]				
		None	1	2	3	4
Coin-Operated[b]						
Self-Service	577	535	220	0	0	0
Plant-Operated	3,891	985	0	0	0	0
Total	4,468	1,520	220	0	0	0
Commercial[b]						
Market A	13,222	0	0	0	0	0
Market B	4,052	4,052	0	0	0	0
Market C	22,595	0	0	0	0	0
Market D	229,516	31,320	30,828	29,692	28,263	25,973
Market E	156,068	77,223	74,721	69,253	64,913	59,491
Market F	146,730	80,185	77,547	71,791	67,263	61,652
Total	571,949	192,780	183,097	170,736	160,439	147,117
Industrial[c]	170,902	34,180	34,180	34,180	34,180	34,180

[a]Total output and affected output values computed using average output values reported in Tables 2-5 and 2-7, the distribution of facilities in Table 2-13, and the distribution of affected facilities in Table 7-3.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

The number of affected facilities represents about 53 percent of all coin-operated facilities with dry cleaning equipment. The impact is split between plants with self-service equipment and those without. Those with plant-operated equipment comprise the bulk of the affected population. With no cutoff, 34 percent of the coin-operated output will be affected under the candidate alternatives, the majority of which comes from plant-operated machines. Again, the disparity indicates that the average size of facilities affected is smaller than that for unaffected facilities.

In the industrial sector, size cutoffs would have no impact; all of the industrial facilities with dry cleaning machines fall above the largest cutoff. Also notice that the affected population is the same share--20 percent--in terms of the number of facilities and output because the size distribution of affected and unaffected plants does not differ.

7.2 COSTS OF COMPLIANCE

In Section 6 the control options available under each regulatory alternative are identified and the method for determining which option owners of affected facilities are likely to choose is outlined. In this section, the methods and assumptions used to compute the annualized costs associated with each regulatory alternative are discussed.

Tables 7-6 and 7-7 show the model plant capital and operating costs for CA controls and RC controls, respectively. As noted before, coin-operated and industrial plants do not have the option of retrofitting existing machines with RC controls because these devices are not manufactured for the machine sizes typically used in these two sectors. Capital costs are a function of the machine size and do not differ with different levels of output. Operating costs are a function of output level and are reported for five levels of output based on the corresponding range of annual receipts given below:

Output Level	Annual Receipts Range
1	$0 to 25 thousand
2	$25 to 50 thousand
3	$50 to 75 thousand
4	$75 to 100 thousand
5	Over $100 thousand

TABLE 7-6. MODEL PLANT CAPITAL AND OPERATING COMPLIANCE COSTS FOR CARBON ADSORBER CONTROLS ($1989)[a]

Industry Sector and Model Plant Number	CA Capital Costs ($)	CA Operating Costs by Output Level ($/yr)[b]				
		1	2	3	4	5
Coin-Operated						
1	8,601	6,492	6,466	6,436	6,406	6,140
2	3,540	2,710	2,703	2,695	2,688	2,618
Commercial						
3	6,760	2,887	2,827	2,758	2,689	2,141
4	6,760	2,886	2,827	2,758	2,688	2,138
5	6,760	2,886	2,827	2,757	2,687	2,137
6	6,976	2,895	2,835	2,766	2,696	2,145
7	6,760	2,886	2,826	2,757	2,686	2,134
8	6,760	2,886	2,826	2,757	2,686	2,133
9	6,976	2,895	2,835	2,765	2,695	2,142
10	6,760	2,886	2,826	2,756	2,686	2,132
11	6,760	2,886	2,826	2,756	2,685	2,129
12	6,976	2,895	2,834	2,764	2,693	2,138
Industrial						
13	9,980	2,992	2,922	2,837	2,747	-2,265
14	9,980	2,992	2,922	2,837	2,747	-8,147
15	9,980	2,992	2,922	2,837	2,747	-8,147

[a]Negative values indicate cost savings due to reduced solvent consumption.

[b]Output levels correspond to average annual receipts ranges below:

1 under $25 thousand
2 $25 to $50 thousand
3 $50 to $75 thousand
4 $75 to $100 thousand
5 over $100 thousand

Source: Radian, 1990a.

TABLE 7-7. MODEL PLANT CAPITAL AND OPERATING COMPLIANCE COSTS FOR REFRIGERATED CONDENSOR CONTROLS IN THE COMMERCIAL SECTOR ($1989)[a]

Model Plant Number	RC Capital Costs ($)	RC Operating Costs by Output Level ($/yr)[b]				
		1	2	3	4	5
3	6,283	290	234	169	103	-413
4	6,283	289	232	166	100	-423
5	6,283	289	231	165	98	-430
6	8,424	374	317	250	183	-345
7	6,283	288	230	163	95	-440
8	6,283	288	230	162	93	-444
9	8,424	373	315	248	179	-358
10	6,283	288	229	161	92	-449
11	8,675	383	323	254	184	-363
12	10,811	468	409	340	270	-278

[a]Negative values indicate cost savings due to reduced solvent consumption. Add-on RC control devices are not built for the size machines typically used in the coin-operated and industrial sectors.

[b]Output levels correspond to average annual receipts ranges below:
1 under $25 thousand
2 $25 to $50 thousand
3 $50 to $75 thousand
4 $75 to $100 thousand
5 over $100 thousand

Source: Radian, 1990a.

Note that operating costs decline as output level increases because operating costs are net of solvent recovery savings, and projected solvent recovery savings (negative costs) rise faster than the positive cost components as output increases. Negative values are indicated where solvent savings exceed costs.

The CA capital costs average over $7,000 for commercial facilities with dry-to-dry or transfer machines. Refrigerated condensor capital costs are slightly lower than CA capital costs for dry-to-dry machines in the commercial sector. Carbon adsorber capital costs are about $1,500 lower than RC costs for transfer machines in the commercial sector. However, CA annual operating costs average $1,800 to over $2,000 dollars higher than RC operating costs for machines of both types.

Using these cost inputs, the capital costs of new dry-to-dry machines with built-in vent controls from Table 7-10, and the least cost options identified in the net present cost analysis presented in Section 6, the annualized compliance costs can be computed. Table 7-8 reports the annualized costs of Regulatory Alternative I by model plant and output level. Table 7-9 reports the costs of Regulatory Alternatives II and III. The model plant costs for facilities with dry-to-dry machines are the same for all alternatives. Model plant costs for facilities with transfer machines are lower under Alternative I than under Alternatives II and III. Although the costs per plant do not differ under Alternatives II and III, the number of affected facilities with transfer machines is higher for Alternative III.

As noted previously, facility owners in the commercial and industrial sectors will likely replace their existing machines with new dry-to-dry machines that have built-in control devices. Therefore, capital costs of control equipment are annualized over the remaining life of the existing dry cleaning machine rather than the life of the control device. New machines in the coin-operated sector generally <u>do not</u> have built-in control devices. Capital costs are annualized over the life of the CA (15 years) in the coin-operated sector. For the purposes of this analysis it is assumed that the distribution of the remaining life of existing machines is rectangular and each year one fifteenth of the machines is replaced. Costs are annualized

TABLE 7-8. MODEL PLANT ANNUALIZED COMPLIANCE COSTS FOR REGULATORY ALTERNATIVE I ($1989)[a]

Industry Sector and Model Plant Number	Output Level[b]				
	1	2	3	4	5
Coin-Operated					
1	7,814	7,788	7,759	7,728	7,462
2	3,264	3,258	3,250	3,242	3,173
Commercial					
3	2,271	2,215	2,150	2,084	1,568
4	2,289	2,232	2,166	2,099	1,577
5	2,307	2,249	2,183	2,116	1,588
6	2,946	2,889	2,822	2,755	2,227
7	2,436	2,378	2,310	2,242	1,708
8	2,450	2,391	2,324	2,255	1,718
9	3,125	3,067	2,999	2,930	2,393
10	2,471	2,412	2,344	2,275	1,734
11	3,397	3,338	3,269	3,199	2,651
12	4,075	4,016	3,947	3,877	3,329
Industrial					
13	6,110	6,039	5,955	5,865	852
14	6,110	6,039	5,954	5,864	-5,029
15	6,110	6,039	5,954	5,864	-5,029

[a]Annualized costs are computed using the control costs found in Tables 7-6 and 7-7 and the dry cleaning machine capital costs found in Table 2-10. Discount rates vary by firm financial status: 15.4% for firms in poor financial condition, 12.5% for firms in average financial condition, and 11.0% for firms in good financial condition. In the commercial and industrial sectors costs are annualized over the remaining life of the dry cleaning machine or the life of the control equipment, whichever is shorter. In the coin-operated sector, costs are annualized over the life of the control equipment (15 years).

[b]Output levels correspond to average annual receipts ranges below:
1 under $25 thousand
2 $25 to $50 thousand
3 $50 to $75 thousand
4 $75 to $100 thousand
5 over $100 thousand

TABLE 7-9. MODEL PLANT ANNUALIZED COMPLIANCE COSTS FOR REGULATORY ALTERNATIVES II AND III ($1989)[a]

Industry Sector and Model Plant Number	Output Level[b]				
	1	2	3	4	5
Coin-Operated					
1	7,814	7,788	7,759	7,728	7,462
2	3,264	3,258	3,250	3,242	3,173
Commercial					
3	2,271	2,215	2,150	2,084	1,568
4	2,289	2,232	2,166	2,099	1,577
5	2,307	2,249	2,183	2,116	1,577
6	4,487	4,428	4,360	4,291	3,749
7	2,436	2,378	2,310	2,242	1,708
8	2,450	2,391	2,324	2,255	1,718
9	4,837	4,778	4,708	4,638	4,087
10	2,471	2,412	2,344	2,275	1,734
11	5,052	4,992	4,922	4,851	4,296
12	4,075	4,016	3,947	3,877	3,329
Industrial					
13	6,110	6,039	5,955	5,865	852
14	6,110	6,039	5,954	5,864	-5,029
15	6,110	6,039	5,954	5,864	-5,029

[a]Annualized costs are computed using the control costs found in Tables 7-6 and 7-7 and the dry cleaning machine capital costs found in Table 2-10. Discount rates vary by firm financial status: 15.4% for for firms in poor financial condition, 12.5% for firms in average financial condition, and 11.0% for firms in good financial condition. In the commercial and industrial sectors costs are annualized over the remaining life of the dry cleaning machine or the life of the control equipment, whichever is shorter. In the coin-operated sector, costs are annualized over the life of the control equipment (15 years).

[b]Output levels correspond to average annual receipts ranges below:

1 under $25 thousand
2 $25 to $50 thousand
3 $50 to $75 thousand
4 $75 to $100 thousand
5 over $100 thousand

using a real, after-tax weighted average cost of capital (WACC), that differs depending on their baseline financial status. The share of facilities in each financial status and the corresponding WACC is reported in Section 6.

In some instances it is more cost-effective to accelerate the purchase of a new dry-to-dry machine with a built-in vent control than to retrofit the existing machine. Annualized costs associated with this option are computed by taking the net present cost computed in Eq. 6.3 in Section 6 and computing the annualized value over the remaining life of the existing dry cleaning machine.

7.3 MARKET ADJUSTMENTS

Regulatory controls are likely to disturb the current equilibrium in the dry cleaning industry, resulting in price and output changes and corresponding welfare impacts. Market price and output adjustments are calculated from elasticity estimates, baseline price and output values, and control cost estimates. In the coin-operated and industrial sectors and in Market Models C, D, E, and F in the commercial sector market, impacts are computed based on a competitive market model. Model Markets A and B in the commercial sector represent markets with a single facility in the market area. Impacts in these model markets are computed based on a monopoly model with limit pricing behavior.

Table 7-10 shows the type of market adjustments computed for each sector and model market. Price and output impacts are computed for the coin-operated sector and commercial Markets E and F. No price and output impacts are projected for the industrial sector or Model Markets A through D in the commercial sector. In market areas where unaffected facilities dominate, price and quantity impacts are likely to be zero. This is the case in the industrial sector and in commercial Markets A, C, and D. Model Market B in the commercial sector represents a single affected facility per market area. This facility is not likely to raise prices under any of the alternatives considered because to do so would encourage new entry into the market as discussed in Section 4.

TABLE 7-10. MARKET ADJUSTMENTS COMPUTED FOR EACH SECTOR AND MODEL MARKET IN THE DRY CLEANING INDUSTRY

Sector	Model Market	Price Adjustments	Output Adjustments	Welfare Impacts
Coin-Operated		yes	yes	P,C
Commercial	A	no	no	none
Commercial	B	no	no	P
Commercial	C	no	no	none
Commercial	D	no	no	P
Commercial	E	yes	yes	P,C
Commercial	F	yes	yes	P,C
Industrial		no	no	P

Key: "P" = producer welfare impacts.
"C" = consumer welfare impacts.

All sectors and model markets with affected facilities will incur producer welfare impacts. However, only those markets with price and output adjustments have projected consumer welfare impacts.

7.3.1 Price and Output Adjustments

Economic impacts are quantified through estimated market adjustments in price and output for the coin-operated sector and Model Markets E and F in the commercial sector. Figure 7-1 depicts the supply/demand relationship for a representative market area in these sectors. Pre-regulatory equilibrium occurs at an output level of Q_1 and a price of P_1 per unit (kilogram) of output. The supply curve (S_1) is upward sloping with an elasticity of "ε" and the demand curve (D_1) is downward sloping with an elasticity of "η."

Suppose that installing the cost-effective candidate control technology results in a net cost increase for facilities in the representative market. The market supply curve will shift up from from a position such as S_1 to S_2 in Figure 7-1 with a vertical shift distance equal to the weighted average control cost per unit of output. Assuming that the market demand curve remains stationary in response to technological controls is plausible because

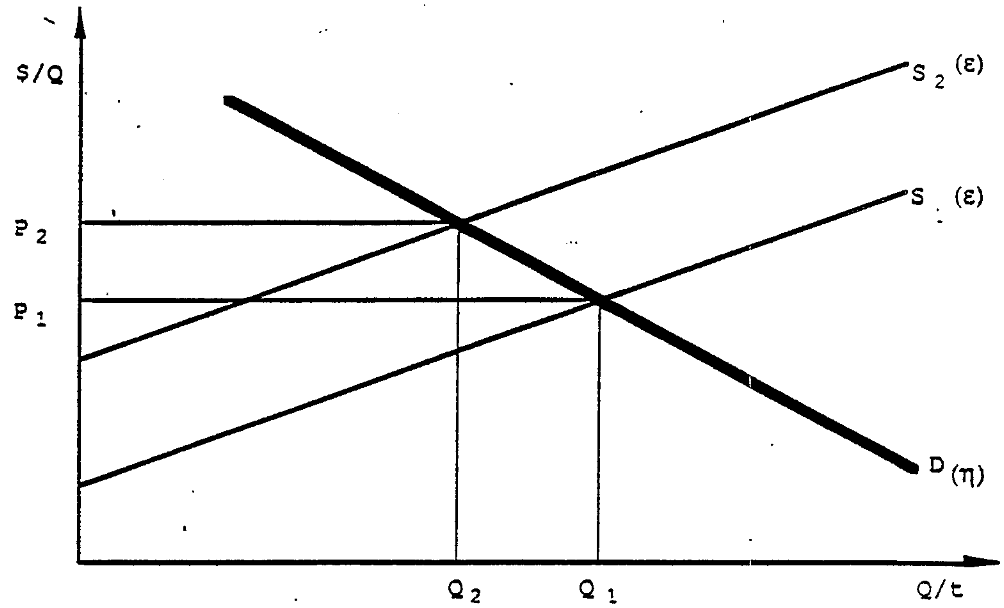


Figure 7-1. Price and Output Adjustments Due to a Market Supply Shift

these controls normally affect only supply-side variables such as production costs. In addition, the candidate control devices will not lessen the quality of the product, further justifying a stationary demand curve. Because the new supply curve now intersects the downward sloping demand curve at a higher point, equilibrium price will increase and equilibrium output will decrease. The magnitude of the new equilibrium price/output combination (P_2, Q_2) is not obvious from the diagram, but it can be computed if baseline price and output values (P_1, Q_1), the demand elasticity (η), the supply elasticity (ε), and the supply shift parameter (1) are known. First, rewrite the inverse supply/demand system in functional form as illustrated below:

$$P = P(Q^s, PPI, CT), \qquad (7.1)$$

$$P = P(Q^d, Pop), \qquad (7.2)$$

where CT is the control technology that leads to the supply curve shift. Next, convert the supply and demand functions to logarithmic form and take the total differential:

$$E(P) = \left[\frac{1}{\varepsilon}\right] E(Q^s) + \lambda_s, \tag{7.3}$$

$$E(P) = \left[\frac{1}{\eta}\right] E(Q^d), \tag{7.4}$$

where $E(\cdot) = \partial Ln(\cdot)$, $\eta = \partial Ln(Q^d)/\partial Ln(P)$, $\varepsilon = \partial Ln(Q^s)/\partial Ln(P)$, and $\lambda_s = \{\partial Ln(P)/\partial Ln(CT)\}\partial Ln(CT)$. The terms E(Pop) and E(PPI) are not included in the above equations because they are exogenous variables and, therefore, unaffected by policy changes.

The parameter λ_s is the percentage shift of the marginal facility's supply function given a change in the control technology. Assuming that there is no correlation between production costs and control costs, the shift in the supply function of the marginal facility may correspond to the lowest control costs (zero in markets with unaffected facilities) or highest control cost per kilogram of output estimated. For this analysis the supply shift is based on the expected value of the percentage change in marginal costs for the given market area. Measured along the price axis, the expected percentage shift of the supply function is equal to the weighted average control cost per unit of output divided by the baseline price:

$$\lambda_s = \frac{\sum_i \left\{ \left[\frac{Q_i}{\sum_i Q_i}\right] CT_i \right\}}{P_1} \tag{7.5}$$

Because there are two equations and two unknowns, supply can now be set equal to demand to solve for E(P):

$$E(P) = \left[\frac{\eta}{\varepsilon}\right] E(P) + \lambda_s, \tag{7.6}$$

$$E(P) = \left[\frac{\varepsilon\lambda_s}{(\varepsilon - \eta)}\right]. \tag{7.7}$$

By definition, $E(P) = \partial Ln(P) = (P_2 - P_1)/P_1$ for "small" changes in price. Solving for the value of P_2 from the expression above and inserting this information into the equation for E(Q) produces the following formulas for P_2 and Q_2:

$$P_2 = P_1 \cdot \left\{ 1 + \left[\frac{\varepsilon\lambda_s}{(\varepsilon - \eta)}\right] \right\}, \tag{7.8}$$

$$Q_2 = Q_1 \cdot \left\{ 1 + \left[\frac{\cdot \eta \varepsilon \lambda_s}{(\varepsilon - \eta)} \right] \right\}. \qquad (7.9)$$

All variables and parameters on the right hand side of Eqs. (7.8) and (7.9) are known, so the new equilibrium price/output combination can be computed from this information.

Baseline price and the projected price impacts are reported in Table 7-11 for each sector of the dry cleaning industry under three regulatory alternatives and five cutoff levels. Average price impacts for the entire commercial sector are not reported in this table because the average impact underestimates price adjustments for markets where affected facilities dominate and overestimates adjustments with no affected or very few affected facilities. Therefore price impacts in the commercial sector are presented by model market in Table 7-12. Model Markets A and C do not experience price impacts because no affected facilities are represented in these markets. Facilities in Market B do not raise prices because of limit pricing practices to deter entry of new facilities. Prices do not change in response to the regulatory alternatives in Market D because unaffected facilities dominate in this market model. Price impacts in Markets E and F represent the weighted average price impacts for all facilities in these market models.

Total baseline output and projected output impacts corresponding to the price impacts reported in Table 7-11 are reported in Table 7-13. The total reduction in output for the commercial sector is from Model Markets E and F. Table 7-14 reports the output adjustments for each market model in the commercial sector. It is evident from Tables 7-11 through 7-14 that price and output vary in magnitude among sectors and across size cutoff levels.

In the commercial and coin-operated sector, size cutoffs reduce the number of affected facilities and the share of affected output. As the share of affected output is reduced, the average compliance cost per kilogram of output for the market area declines. All else equal, a lower compliance cost per unit of output results in lower price and output adjustments. In the commercial sector size cutoff levels affect price and output adjustments for two additional reasons. First, the annual cost per affected facility declines as the level of output increases because of increased solvent recovery savings

TABLE 7-11. PRICE ADJUSTMENTS FOR EACH SECTOR OF THE DRY CLEANING INDUSTRY BY REGULATORY ALTERNATIVE AND SIZE CUTOFF

Industry Sector and Regulatory Alternative	Baseline Price ($/kg)	Size Cutoff[a] (Percent Change from Baseline)				
		None	1	2	3	4
Coin-Operated (self-service)						
Reg I, II, & III[b]	1.65	96.32	23.50	0	0	0
Coin-Operated (plant-operated)						
Reg I, II, & III[b]	6.34	1.07	0	0	0	0
Commercial						
Reg I[b]	6.34	c	c	c	c	c
Reg II	6.34	c	c	c	c	c
Reg III	6.34	c	c	c	c	c
Industrial						
Reg I, II, & III[b, d]	2.00	0	0	0	0	0

[a]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

[b]Regulatory Alternatives I, II, and III are identical for the Coin-Operated and Industrial Sectors.

[c]See Table 7-12 for estimates of price adjustments for the Commercial Sector.

[d]Because unaffected facilities dominate the industry and dry cleaning accounts for less than 8% of total output for the industry (including garments cleaned in water), the Industrial sector will likely not adjust prices in response to the alternatives.

TABLE 7-12. PRICE ADJUSTMENTS FOR MODEL MARKETS IN THE COMMERCIAL SECTOR BY REGULATORY ALTERNATIVE AND SIZE CUTOFF (PERCENTAGE CHANGE FROM BASELINE)[a]

Model Market and Regulatory Alternative	Baseline Price ($/kg)	Size Cutoff[b] (percentage change from baseline)				
		None	1	2	3	4
Reg I						
Market A	6.34	0	0	0	0	0
Market B	6.34	0	0	0	0	0
Market C	6.34	0	0	0	0	0
Market D	6.34	0	0	0	0	0
Market E	6.34	0.68	0.52	0.38	0.32	0.26
Market F	6.34	0.77	0.60	0.43	0.36	0.30
Reg II						
Market A	6.34	0	0	0	0	0
Market B	6.34	0	0	0	0	0
Market C	6.34	0	0	0	0	0
Market D	6.34	0	0	0	0	0
Market E	6.34	0.85	0.65	0.47	0.40	0.33
Market F	6.34	0.96	0.74	0.53	0.45	0.37
Reg III						
Market A	6.34	0	0	0	0	0
Market B	6.34	0	0	0	0	0
Market C	6.34	0	0	0	0	0
Market D	6.34	0	0	0	0	0
Market E	6.34	0.98	0.78	0.58	0.49	0.41
Market F	6.34	1.07	0.85	0.63	0.54	0.45

[a]Adjustments are zero for facilities in Model Markets A and C because no affected facilities are represented in these markets. Adjustments are zero for facilities in Markets B and D due to full cost absorption by affected facilities in these markets.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

TABLE 7-13. OUTPUT ADJUSTMENTS FOR EACH SECTOR OF THE DRY CLEANING INDUSTRY BY REGULATORY ALTERNATIVE AND SIZE CUTOFF[a]

Industry Sector and Regulatory Alternative	Baseline Output[a] (Mg/yr)	Size Cutoff[b] (Percentage Change from Baseline)				
		None	1	2	3	4
Coin-Operated (self-service)						
Reg I, II, & III[c]	577	-83.01	-25.52	0	0	0
Coin-Operated (plant-operated)						
Reg I, II, & III[c]	3,891	-1.17	0	0	0	0
Commercial						
Reg I	571,949	-0.42	-0.32	-0.23	-0.19	-0.16
Reg II	571,949	-0.52	-0.40	-0.29	-0.24	-0.20
Reg III	571,949	-0.59	-0.47	-0.35	-0.29	-0.24
Industrial						
Reg I, II, & III[c]	170,902	0	0	0	0	0

[a]Total output includes output from facilities that use PCE and facilities that use other solvents.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

[c]Regulatory Alternatives I, II, and III are identical for the Coin-Operated and Industrial Sectors.

TABLE 7-14. OUTPUT ADJUSTMENTS FOR MODEL MARKETS IN THE COMMERCIAL SECTOR BY REGULATORY ALTERNATIVE AND SIZE CUTOFF[a]

Model Market and Regulatory Alternative	Baseline Output (Mg/yr)	Size Cutoff[b] (percentage change from baseline)				
		None	1	2	3	4
Reg I						
Market A	13,222	0	0	0	0	0
Market B	3,819	0	0	0	0	0
Market C	25,476	0	0	0	0	0
Market D	227,709	0	0	0	0	0
Market E	155,823	-0.74	-0.57	-0.41	-0.34	-0.28
Market F	145,898	-0.85	-0.65	-0.47	-0.39	-0.32
Total Reg I[c]	571,949	-0.42	-0.32	-0.23	-0.19	-0.16
Reg II						
Market A	13,222	0	0	0	0	0
Market B	3,819	0	0	0	0	0
Market C	25,476	0	0	0	0	0
Market D	227,709	0	0	0	0	0
Market E	155,823	-0.92	-0.71	-0.51	-0.43	-0.36
Market F	145,898	-1.05	-0.81	-0.58	-0.49	-0.41
Total Reg II[c]	571,949	-0.52	-0.40	-0.29	-0.24	-0.20
Reg III						
Market A	13,222	0	0	0	0	0
Market B	4,052	0	0	0	0	0
Market C	22,595	0	0	0	0	0
Market D	229,516	0	0	0	0	0
Market E	146,730	-1.06	-0.85	-0.63	-0.54	-0.44
Market F	156,068	-1.17	-0.93	-0.68	-0.58	-0.48
Total Reg III[c]	571,949	-0.59	-0.47	-0.35	-0.29	-0.24

[a]Adjustments are zero for facilities in Model Markets A and C because no affected facilities are represented in these markets. Adjustments are zero for facilities in markets B and D due to full cost absorption by affected facilities in these markets.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

[c]Weighted average output adjustments.

(see Tables 7-8 and 7-9). In addition, the share of facilities with baseline vent controls is significantly higher for large facilities than for small facilities. These factors taken together result in lower average control cost per kilogram of output and thus lower price and output adjustments at higher cutoff levels.

Equilibrium price in the commercial market is estimated to increase 0.98 percent for markets where affected dry cleaners represent about half of all facilities (Market E) under the most stringent regulatory scenario. Price adjustments are projected to be about 1.07 percent for market areas where affected cleaners dominate (Market F). This amounts to pennies per kilogram of clothes cleaned in either case. Corresponding output adjustments in these markets are about 1.06 percent and 1.17 percent, respectively.

As indicated in Section 4, owners of coin-operated dry cleaning equipment are limited in the amount of a cost increase that can be passed along to consumers in the form of a price increase. The maximum price that can be charged for self-service dry cleaning is equal to the maximum post-regulatory commercial price less the minimum opportunity cost of time ($3.00) estimated in Section 4. Under Regulatory Alternative III with no cutoff, facilities in commercial Market F raise price to $6.41 per kilogram of clothes cleaned. This represents the maximum projected post-regulatory price in the commercial sector. Therefore, self-service coin-operated facilities cannot raise prices above $3.41 per kilogram. Likewise, plant-operated facilities in the coin-operated sector are not able to raise prices above the maximum post-regulatory price in the commercial sector. The price and quantity adjustments projected for the coin-operated sector are described below.

The self-service coin-operated sector would experience the most severe equilibrium adjustment from baseline values. Projected equilibrium price would increase from $1.65 to $3.24, or 96.32 percent with no cutoff. Output would decrease by 83.01 percent from 577 Mg per year to 98 Mg per year. Adjustments for plant-operated facilities are not as severe. Average price is projected to increase by about 1.07 percent and output is expected to decrease by 1.17 percent. Based on these estimated impacts, the average price at plant-operated facilities in this sector will rise from $6.34 to $6.41 and output will decline from a total of 3,891 Mg per year to 3,846 Mg per year.

7.3.2 Welfare Effects

The determining costs of a regulatory policy are measured by the change in social welfare that it generates. Welfare impacts often extend to many individuals and industries in an economy. However, estimating the welfare impacts beyond the directly affected markets is generally cost-prohibitive because the resource costs of such a task may exceed the value of the indirect welfare effects that are measured.

Producer welfare impacts result from increased costs of production that are fully or partially absorbed by the facility. Facilities that are unable to pass along any price increase must absorb the total increase in costs. Producer welfare impacts in these markets are equivalent to the costs of control. This scenario describes facilities in commercial Markets B and D. Facilities that are located in market areas where a price increase is likely are able to pass along a portion of the increased costs of production. The producer welfare impact in these markets is equivalent to some portion of the compliance costs depending on the relative elasticity of supply and demand.

Consumers of dry cleaning services experience welfare impacts in markets where price and output adjustments occur. Consumer welfare impacts in markets represented by commercial Model Markets B and D are zero even though affected facilities are in these market areas because price is not affected.

Figure 7-2 depicts the approach used to estimate welfare changes for a representative market with price and output impacts. Baseline equilibrium occurs at the intersection of the demand curve, D_1, and supply curve, S_1. Price is at the level of P_1, with a corresponding output level of Q_1. Assuming the cost-effective candidate NESHAP control increases the weighted average unit production costs in this market, the supply curve will shift up to a position such as S_2. Control costs should not affect the demand relationship in the industry; assuming the demand curve remains stationary is plausible. The new equilibrium position is characterized by a price/output combination of (P_2, Q_2). The welfare changes attributable to the candidate NESHAP controls can be computed directly from Figure 7-2.

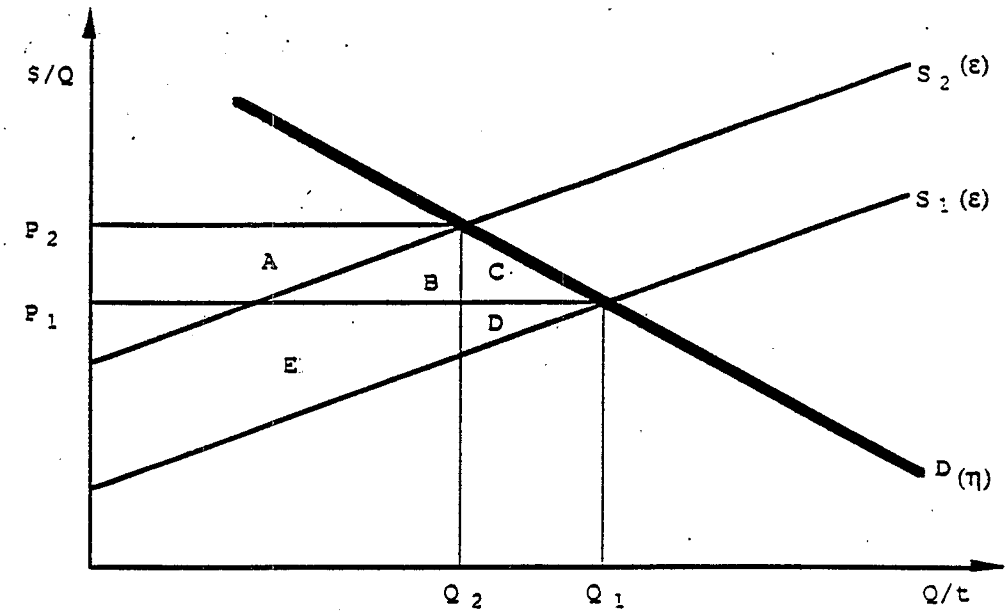


Figure 7-2. Welfare Change Estimation

In a market environment, typically consumers and producers of the good or service derive welfare from a market transaction. The difference between the maximum price consumers are willing to pay for a good or service and the price they actually pay is referred to as consumer surplus. Consumer surplus is measured as the area under the demand curve and above the price of the product. Alternatively, producers derive a surplus from a market transaction if the product price is above the average variable cost of production. Producer surplus is measured as the area above the supply curve and below the market price.

The downward sloping industry demand curve above the baseline price of P_1 in Figure 7-2 indicates a positive consumer surplus. It is also evident that consumers lose some of that surplus when the market price increases from P_1 to P_2. Specifically, the loss in consumer surplus is the sum of areas A + B + C, or the area under the demand curve and between the equilibrium prices. The slope and position of the market supply curve indicates that producers are also receiving a surplus at the baseline price. NESHAP control costs cause producers to lose the surplus area E + D and gain the area A, but the slope and position of the demand and supply curves assures a producer surplus loss as the net effect.

The sum of the producer and consumer surplus losses is an estimate of the loss in social welfare due to the candidate NESHAP control. The net welfare loss is equal to the area E + B + C + D in Figure 7-2. Estimates of the surplus changes for consumers and producers and the resulting change in social welfare are presented in Table 7-15 through Table 7-20. These welfare impacts are projected for the first year after the regulation is in effect. Lesser losses will be incurred in 14 subsequent years because existing uncontrolled machines are being replaced with controlled machines upon retirement even at baseline. Estimated welfare impacts are zero fifteen years after the effective date of the regulation assuming that the current stock of uncontrolled dry cleaning machines would have been entirely replaced with controlled machines in this time period.

Given the relative shifts in equilibrium price and output predicted for self-service coin-operated facilities, the magnitude of the welfare change estimate for the coin-operated sector is larger than either the commercial or industrial sector value relative to the size of the sector. The estimated change in social welfare of $6,250,000 is especially significant in comparison to the size of the coin-operated sector. As discussed earlier, this sector of the industry is the smallest with a declining growth rate in output and number of plants that has continued for several years. In contrast to the estimated Regulatory Alternative III welfare loss in the commercial sector ($47,600,000), this figure does not appear excessive; but the commercial sector is more than 125 times as large in terms of yearly dry cleaning output. Along the same lines, estimated price and output adjustments in the commercial sector are relatively minor, leading to a welfare loss estimate that is modest in comparison to the size of the sector.

Despite the predicted welfare loss in the coin-operated and commercial sectors, producer and consumer surplus can actually increase if a regulatory control leads to cost savings that cause the price of the product to fall instead of rise. In such a case, social welfare would increase. This scenario is applicable to the industrial sector where a gain in welfare of $274,000 is predicted.

TABLE 7-15. CONSUMER WELFARE IMPACTS FOR EACH SECTOR OF THE DRY CLEANING INDUSTRY BY REGULATORY ALTERNATIVE AND SIZE CUTOFF ($ THOUSANDS)[a]

Industry Sector and Regulatory Alternative	Size Cutoff[b]				
	None	1	2	3	4
Coin-Operated (self-service)					
Reg I, II, & III[c]	-537	-195	0	0	0
Coin-Operated (plant-operated)					
Reg I, II, & III[c]	-262	0	0	0	0
Commercial					
Reg I	-13,800	-10,600	-7,700	-6,460	-5,320
Reg II	-17,200	-13,300	-9,500	-8,080	-6,680
Reg III	-19,500	-15,600	-11,500	-9,860	-8,180
Industrial					
Reg I, II, & III[c]	0	0	0	0	0

[a]Values are expressed in 1989 dollars and rounded to 3 significant digits. Consumer welfare losses in first year of regulation. Costs will be incurred in subsequent years but will decline over time. Recurring annual costs will be zero 15 years after the effective date of the regulation assuming that the current stock of uncontrolled machines would be replaced by controlled machines in the baseline over this time period.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

[c]Regulatory Alternatives I, II, and III are identical for the Coin-Operated and Industrial Sectors.

TABLE 7-16. CONSUMER WELFARE IMPACTS FOR MODEL MARKETS IN THE COMMERCIAL SECTOR BY REGULATORY ALTERNATIVE AND SIZE CUTOFF ($ THOUSANDS)[a]

Model Market and Regulatory Alternative	Size Cutoff[b]				
	None	1	2	3	4
Reg I					
Market A	0	0	0	0	0
Market B	0	0	0	0	0
Market C	0	0	0	0	0
Market D	0	0	0	0	0
Market E	-6,700	-5,160	-3,730	-3,130	-2,580
Market F	-7,130	-5,490	-3,970	-3,330	-2,740
Total Reg I	-13,800	-10,600	-7,700	-6,460	-5,320
Reg II					
Market A	0	0	0	0	0
Market B	0	0	0	0	0
Market C	0	0	0	0	0
Market D	0	0	0	0	0
Market E	-8,340	-6,440	-4,600	-3,920	-3,240
Market F	-8,870	-6,850	-4,900	-4,170	-3,440
Total Reg II	-17,200	-13,300	-9,500	-8,080	-6,680
Reg III					
Market A	0	0	0	0	0
Market B	0	0	0	0	0
Market C	0	0	0	0	0
Market D	0	0	0	0	0
Market E	-9,600	-7,680	-5,690	-4,870	-4,010
Market F	-9,930	-7,910	-5,830	-4,990	-4,130
Total Reg III	-19,500	-15,600	-11,500	-9,860	-8,180

[a]Impacts are zero for facilities in Model Markets A and C because no affected facilities are represented in these markets. Impacts are zero for facilities in Markets B and D due to full cost absorption by affected facilities in these markets. Values are express in 1989 dollars and rounded to 3 significant digits. Details may not sum to totals due to rounding. Consumer welfare losses in first year of regulation. Costs will be incurred in subsequent years but will decline over time. Recurring annual costs will be zero 15 years after the effective date of the regulation assuming that the current stock of uncontrolled machines would be replaced by controlled machines in the baseline over this time period.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

TABLE 7-17. PRODUCER WELFARE IMPACTS FOR EACH SECTOR OF THE DRY CLEANING INDUSTRY BY REGULATORY ALTERNATIVE AND SIZE CUTOFF ($ THOUSANDS)[a]

Industry Sector and Regulatory Alternative	Size Cutoff[b]				
	None	1	2	3	4
<u>Coin-Operated (self-service)</u>					
Reg I, II, & III[c]	-1,140	-193	0	0	0
<u>Coin-Operated (plant-operated)</u>					
Reg I, II, & III[c]	-4,320	0	0	0	0
<u>Commercial</u>					
Reg I	-15,000	-8,110	-5,850	-4,900	-4,040
Reg II	-19,800	-10,100	-7,230	-6,150	-5,070
Reg III	-28,070	-17,300	-13,600	-11,800	-9,810
<u>Industrial</u>					
Reg I, II, & III[c]	274	274	274	274	274

[a]Values are expressed in 1989 dollars and rounded to 3 significant digits. Producer welfare losses in first year of regulation. Costs will be incurred in subsequent years but will decline over time. Recurring annual costs will be zero 15 years after the effective date of the regulation assuming that the current stock of uncontrolled machines would be replaced by controlled machines in the baseline over this time period.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

[c]Regulatory Alternatives I, II, and III are identical for the Coin-Operated and Industrial Sectors.

TABLE 7-18. PRODUCER WELFARE IMPACTS FOR MODEL MARKETS IN THE COMMERCIAL SECTOR BY REGULATORY ALTERNATIVE AND SIZE CUTOFF ($ THOUSANDS)[a]

Model Market and Regulatory Alternative	Size Cutoff[b]				
	None	1	2	3	4
Reg I					
Market A	0	0	0	0	0
Market B	-4,290	0	0	0	0
Market C	0	0	0	0	0
Market D	-824	-627	-452	-378	-310
Market E	-4,780	-3,630	-2,620	-2,190	-1,800
Market F	-5,090	-3,860	-2,790	-2,330	-1,920
Total Reg I	-15,000	-8,110	-5,850	-4,900	-4,040
Reg II					
Market A	0	0	0	0	0
Market B	-6,630	0	0	0	0
Market C	0	0	0	0	0
Market D	-1,010	-782	-558	-473	-389
Market E	-5,890	-4,530	-3,230	-2,750	-2,270
Market F	-6,280	-4,830	-3,440	-2,920	-2,410
Total Reg II	-19,800	-10,100	-7,230	-6,150	-5,070
Reg III					
Market A	0	0	0	0	0
Market B	-7,070	0	0	0	0
Market C	0	0	0	0	0
Market D	-7,160	6,330	-5,480	-4,840	-4,070
Market E	-6,800	-5,420	-4,000	-3,420	-2,840
Market F	-7,040	-5,590	-4,100	-3,500	-2,900
Total Reg III	-28,070	-17,300	-13,600	-11,800	-9,810

[a]Impacts are zero for facilities in Model Markets A and C because no affected facilities are represented in these markets. Values are express in 1989 dollars and rounded to 3 significant digits. Details may not sum to totals due to rounding. Producer welfare losses in first year of regulation. Costs will be incurred in subsequent years but will decline over time. Recurring annual costs will be zero 15 years after the effective date of the regulation assuming that the current stock of uncontrolled machines would be replaced by controlled machines in the baseline over this time period.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

TABLE 7-19. NET WELFARE IMPACTS FOR EACH SECTOR OF THE DRY CLEANING INDUSTRY BY REGULATORY ALTERNATIVE AND SIZE CUTOFF ($ THOUSANDS)[a]

Industry Sector and Regulatory Alternative	Size Cutoff[b]				
	None	1	2	3	4
<u>Coin-Operated (self-service)</u>					
Reg I, II, & III[c]	-1,670	-388	0	0	0
<u>Coin-Operated (plant-operated)</u>					
Reg I, II, & III[c]	-4,580	0	0	0	0
<u>Commercial</u>					
Reg I	-29,000	-18,800	-13,600	-11,400	-9,360
Reg II	-37,000	-23,400	-16,700	-14,200	-11,700
Reg III	-47,600	-32,900	-25,100	-21,600	-18,000
<u>Industrial</u>					
Reg I, II, & III[c]	274	274	274	274	274

[a]Values are expressed in 1989 dollars and rounded to 3 significant digits. Details may not sum to totals due to rounding. Net welfare impacts are the sum of producer and consumer welfare impacts. Producer and consumer welfare losses in first year of regulation. Costs will be incurred in subsequent years but will decline over time. Recurring annual costs will be zero 15 years after the effective date of the regulation assuming that the current stock of uncontrolled machines would be replaced by controlled machines in the baseline over this time period.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

[c]Regulatory Alternatives I, II, and III are identical for the Coin-Operated and Industrial Sectors.

TABLE 7-20. NET WELFARE IMPACTS FOR MODEL MARKETS IN THE COMMERCIAL SECTOR BY REGULATORY ALTERNATIVE AND SIZE CUTOFF ($ THOUSANDS)[a]

Model Market and Regulatory Alternative	Size Cutoff[b]				
	None	1	2	3	4
Reg I					
Market A	0	0	0	0	0
Market B	-4,290	0	0	0	0
Market C	0	0	0	0	0
Market D	-824	-627	-452	-378	-309
Market E	-11,600	-8,790	-6,350	-5,320	-4,380
Market F	12,300	-9,350	-6,760	-5,660	-4,660
Total Reg I	-29,000	-18,800	-13,600	-11,400	-9,360
Reg II					
Market A	0	0	0	0	0
Market B	-6,630	0	0	0	0
Market C	0	0	0	0	0
Market D	-1,010	-782	-557	-473	-389
Market E	-14,200	-11,000	-7,840	-6,660	-5,500
Market F	-15,200	-11,700	-8,340	-7,090	-5,860
Total Reg II	-37,000	-23,400	-16,700	-14,200	-11,700
Reg III					
Market A	0	0	0	0	0
Market B	-7,070	0	0	0	0
Market C	0	0	0	0	0
Market D	-7,160	-6,330	-5,480	-4,840	-4,070
Market E	-16,400	-13,100	-9,700	-8,290	-6,880
Market F	-17,000	-13,500	-9,940	-8,490	-7,040
Total Reg III	-47,600	-32,900	-25,100	-21,600	-18,000

[a]Impacts are zero for facilities in Model Markets A and C because no affected facilities are represented in these markets. Values are express in 1989 dollars and rounded to 3 significant digits. Details may not sum to totals due to rounding. Net welfare impacts are the sum of producer and consumer welfare impacts. Producer and consumer welfare losses in first year of regulation. Costs will be incurred in subsequent years but will decline over time. Recurring annual costs will be zero 15 years after the effective date of the regulation assuming that the current stock of uncontrolled machines would be replaced by controlled machines in the baseline over this time period.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

Aggregating the welfare effects from each sector leads to an industry estimate of the regulatory cost. The total industry welfare cost is estimated to be $43,250,000 under Regulatory Alternative II with no size cutoff. Consumers of dry cleaning services are projected to lose a relatively smaller portion of their welfare ($18,000,000) than producers ($30,000,000). With a size cutoff corresponding to $100,000 in annual receipts (cutoff 4) welfare impacts are considerably lower. Producers lose an estimated $4,800,000 and consumers lose $6,680,000 for a net welfare loss of $11,400,000.

7.3.3 Plant Closures

To comply with a regulatory standard, facilities will normally incur control costs and may have to reduce production levels, modify production processes, or, as a last resort, shut down. In the short run, the decision to shut down depends on the relationship between the price of the service and the average variable cost of production. The position of the average variable cost curve is difficult to estimate without the aid of detailed financial data including input prices. As a result, this section offers qualitative impacts based on output adjustments for each sector. Closures measured in this way provide an estimate of plant closures that is net of new plants entering the market. In other words, if the regulatory alternative results in 10 plant closures and 7 plant start-ups, the value estimated in this analysis corresponds to 3 net plant closures. Although this may tend to underestimate the total number of plants closing, two additional assumptions have the effect of making the estimates worst-case in terms of net closures. First, it is assumed that facilities do not reduce capacity utilization, but rather, the entire output reduction is accounted for by facilities shutting down. In addition, it is assumed that the smallest plants affected account for all the plant closures.

Tables 7-21 and 7-22 show the number of facilities in each sector and model market that would shut down in net if the entire output reduction was accounted for by the smallest facilities leaving the industry. Net plant closures will not likely reach these levels, but for policy evaluation this worst-case analysis of net closures is helpful.

TABLE 7-21. PROJECTED WORST-CASE NET PLANT CLOSURES IN EACH SECTOR OF THE DRY CLEANING INDUSTRY BY REGULATORY ALTERNATIVE AND SIZE CUTOFF[a]

Industry Sector and Regulatory Alternative	Size Cutoff[b]				
	None	1	2	3	4
Coin-Operated (self-service)					
Reg I, II, & III[c]	190	36	0	0	0
Coin-Operated (plant-operated)					
Reg I, II, & III[c]	163	0	0	0	0
Commercial					
Reg I	1,001	337	147	88	23
Reg II	1,246	421	182	110	28
Reg III	1,415	493	221	135	34
Industrial					
Reg I, II, & III[c]	0	0	0	0	0

[a]Projected net closures are computed by dividing the estimated change in output (Table 7-13) measured in kg per year by the minimum size affected plant. Values reflect the assumption that plants do not reduce capacity utilization.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

[c]Regulatory Alternatives I, II, and III are identical for the Coin-Operated and Industrial Sectors.

TABLE 7-22. PROJECTED WORST-CASE NET PLANT CLOSURES IN EACH MODEL MARKET OF THE COMMERCIAL SECTOR BY REGULATORY ALTERNATIVE AND SIZE CUTOFF[a]

Model Market and Regulatory Alternative	Size Cutoff[b]				
	None	1	2	3	4
Reg I					
Market A	0	0	0	0	0
Market B	0	0	0	0	0
Market C	0	0	0	0	0
Market D	0	0	0	0	0
Market E	485	163	71	43	11
Market F	516	174	76	45	12
Total Reg I	1,001	337	147	88	23
Reg II					
Market A	0	0	0	0	0
Market B	0	0	0	0	0
Market C	0	0	0	0	0
Market D	0	0	0	0	0
Market E	604	204	88	53	14
Market F	642	217	94	57	14
Total Reg II	1,246	421	182	110	28
Reg III					
Market A	0	0	0	0	0
Market B	0	0	0	0	0
Market C	0	0	0	0	0
Market D	0	0	0	0	0
Market E	695	243	109	67	17
Market F	720	250	112	68	17
Total Reg III	1,415	493	221	135	34

[a]Projected net closures are computed by dividing the estimated change in output (Table 7-14) measured in kg per year by the minimum size affected plant. Values reflect the assumption that plants do not reduce capacity utilization.

[b]Size cutoff levels are based on baseline consumption of perchloroethylene (PCE). The cutoff levels correspond to target levels of annual receipts and differ depending on the type of dry cleaning machine used. See Table 7-1 for description of cutoff levels.

Once again, the self-service coin-operated facilities would experience the most significant impacts with a potential for 190 net plant closures without a size cutoff. This represents 89 percent of the self-serve facilities. Projected worst-case net closures of plant-operated facilities in this sector total 163 with no size cutoff. This represents about 6 percent of the plant-operated facilities in the coin-operated sector. Because dry cleaning represents only about 10 percent of a coin-operated laundry's total receipts, this estimate of plant closure is defined as the estimated number of coin laundries that would discontinue their dry cleaning line of business. Given past history and recent trends of the coin-operated sector some "plant closures" will probably occur, but it is uncertain whether they will be caused by regulatory compliance costs or a naturally declining growth rate.

Model Markets E and F in the commercial sector represent markets in which output reductions are likely. Based on the estimated output reductions and the minimum affected plant size, potential net closures in these two model markets total 1,415 under Regulatory Alternative III with no cutoff. However, in each of these model markets estimated output reductions are less than 2 percent of total output.

In view of the size of the estimated output reduction, commercial plants will probably adjust production levels without actually closing their facilities. Evidence from Census data indicates that facilities do respond to changes in the quantity demanded by increasing or reducing output per facility. Census data indicate that commercial facilities with payroll were operating at higher output levels on average in 1987 than in 1982. Using data on average annual receipts, the number of plants, the base price, and the share of receipts from dry cleaning activities, the average facility dry cleaned 24,489 kilograms of clothing in 1982 and 28,335 kilograms in 1987. One industry spokesman indicated that these changes do not reflect a trend toward larger dry cleaning plants; rather, plants are operating at a higher capacity utilization (Fisher, 1990a).

Finally, no plant closures are projected for the industrial sector in view of the cost savings expected for this sector.

7.3.4 Employment Effects

The dry cleaning NESHAP may cause short-run price impacts in the three dry cleaning sectors being examined in this analysis. If the short-run effect of a regulatory alternative is to increase the equilibrium price of dry cleaning services (in a given sector), then the short-run market-clearing output of services will be lower than the baseline output. If the market-clearing output declines, so may the demand for labor services by operators of dry cleaning facilities. Indeed, the reduction of labor demand may be approximately proportional to the reduction in demand for dry cleaning services. Current employees in dry cleaning facilities may incur a welfare loss in the form of reduced pay or lost jobs. This section discusses the anticipated employment effects of the dry cleaning NESHAP.

Facilities subject to regulation under the NESHAP are generally classified in one of three four-digit Standard Industrial Classifications (SICs): 7215 (Coin-operated laundries and dry cleaning), 7216 (Dry cleaning plants, except rug cleaning), and 7218 (Industrial launderers). Nearly all industrial laundering facilities (SIC 7218) are already in compliance with the regulatory alternatives considered and those facilities that might be affected have a near-perfect substitute for dry cleaning--water laundering. In addition, facilities in this sector are projected to realize a cost savings. Consequently, the anticipated output impacts on industrial launderers are likely to be zero, so employment effects in this sector are not considered further.

The employment effects in the coin-operated dry cleaning sector are also not presented, but for a very different reason. The economic impacts analysis indicates that the NESHAP would cause substantial facility closures unless EPA exempts small facilities. EPA will thus probably exempt small coin-operated facilities, effectively exempting them all. Consequently, the employment effects of the NESHAP are expected to be minor.

Effectively, this leaves commercial dry cleaning plants (SIC 7216) as the potentially-affected population. Two employment effects of the NESHAP in the commercial sectors are considered: employee displacements and employee displacement costs. Displacements are job terminations that result from cut-backs at operating facilities and/or plant closures. Displacement costs are welfare losses incurred by those workers displaced by the NESHAP.

Employee Displacements. For reasons discussed in Section 4, the NESHAP will have no long-run price or quantity impacts relative to baseline. Briefly stated, retiring controlled and uncontrolled dry cleaning machines are being replaced at baseline by controlled machines, so the long-run baseline price of dry cleaning services already reflects control costs. Consequently, the NESHAP causes no long-run quantity impacts either, implying no change in long-run commercial dry cleaning sector employment.

The NESHAP may nonetheless cause short-run disturbances in price, output, and employment in the commercial dry cleaning sector. Aggregate short-run output reductions are projected to range from 0.42 percent of baseline for Regulatory Alternative I to 0.59 percent of baseline for Regulatory Alternative III. With market quantity impacts below one percent of baseline under all alternatives, conceivably the market adjustment will occur through output reductions at many facilities rather than through complete closures at relatively few. If, however, facilities are affected in one or more markets with baseline average variable costs relatively close to price, then these facilities will likely close.

Annualized compliance costs under Regulatory Alternatives II and III are in the neighborhood of $2,000 to $5,000 for most affected facilities (see Table 7-9). An annualized cost of $4,500 represents 4.8 percent of receipts of a facility with annual receipts of $94,000, 6.7 percent of receipts of a $67,000 facility, 11 percent of receipts of a $41,000 facility, and 25 percent of receipts of an $18,000 facility. Affected facilities in some markets will be unable to pass along cost increases even in the short-run, and those in other markets will be able to pass along cost increases only for a short time until new facilities open. Such facilities may be unable to absorb annualized compliance costs as high as 25 percent of receipts. Some closures will likely occur.

Because closures are likely to occur, and output reductions among operating facilities can themselves result in worker displacements, this analysis assumes that short-run employment impacts of regulatory alternatives are proportional to projected output effects. An estimated 176,836 workers are on payroll at commercial dry cleaning plants in 1991.[1] The worker displacements of the three Regulatory Alternatives at various size cutoffs implied by the methodology and assumptions are presented in Table 7-23.

TABLE 7-23. PROJECTED WORKER DISPLACEMENTS[a]

Regulatory Alternative	Size Cutoff				
	None	1	2	3	4
I	743	566	407	336	283
II	920	707	513	424	354
III	1,043	831	619	513	424

[a]Commercial dry cleaning sector, payroll employees only, assuming 1991 baseline employment of 176,836 workers and short-run output reductions from Table 7-13.

Employee Displacement Costs. Displaced workers suffer welfare losses through several mechanisms (see Hamermesh, 1989; Maxwell, 1989; Blinder, 1988; Flaim, 1984; and Gordon, 1978):

- foregone wages and benefits during job search,
- out-of-pocket search costs,
- diminished wages and/or job satisfaction at new jobs, and
- psychological costs.

Displacement risk, like risks of injury, risks of death, or otherwise unpleasant working conditions, is a negative job attribute for which workers receive compensation in competitive labor markets (Abowd and Ashenfelter, 1981). Abowd and Ashenfelter (1981) found that the labor market compensates anticipated layoffs and unemployment by 2 to 6 percent higher wages per year. Topel (1984) used a hedonic wage function to estimate that an anticipated one-point increase in the probability of unemployment (e.g. from 6 per hundred

[1]There were 163,369 payroll workers in the commercial sector in 1987 (U.S. Department of Commerce, 1990b). The 1991 estimate is computed based on the 1987 value and a 2 percent annual growth rate (see Table 2-9).

workers to 7 per hundred workers) requires a 2.5 percent increase in wages to compensate workers.

Anderson and Chandran (1987) developed and demonstrated a methodology to compute a willingness-to-pay based estimate of worker displacement using Topel's estimated compensating wage differential. Their method is analogous to that used by economists to estimate the implicit value of a life using labor market data (see Moore and Viscusi, 1990). The hedonic displacement cost estimate conceptually approximates the one-time willingness-to-pay to avoid an involuntary unemployment episode. Theoretically, it includes all worker-borne costs net of any off-setting pecuniary or non-pecuniary "benefits" of unemployment (e.g., unemployment compensation, leisure time enjoyment). The hedonic displacement cost estimate is a net present valuation.

Annual (1991) earnings in the (payroll commercial) dry cleaning industry are $11,504 (U.S. Department of Labor, 1991b). Using Topel's compensating differential estimate and the Anderson-Chandran methodology, dry cleaning workers would demand an annual compensating differential of $288 ($11,504 * .025) to accept a one-point increase in the probability of displacement. It is assumed that they would be willing to pay an equivalent amount to avoid such an increase in the probability of displacement. The implied statistical cost of an involuntary layoff is thus $28,800 ($288/.01).

Regulatory Alternative II would displace a projected total of 920 workers (with no size cutoff). The displacement cost would be $26.5 million. The estimated worker displacement cost of $26.5 million under Regulatory Alternative II with no size cutoff falls to $10.2 million under size cutoff 4. Table 7-24 shows the worker dislocation costs in the commercial sector under each regulatory alternative and size cutoff.

As noted previously, worker displacement costs are computed based on the estimated output reductions in the commercial sector. Output reductions occur as facilities increase prices to cover the increased costs of production due to costs of control. An increase in production costs would have occurred even in the absence of regulation, however, as owners of dry cleaning facilities

TABLE 7-24. PROJECTED WORKER DISPLACEMENT COSTS ($ MILLIONS)[a]

Regulatory Alternative	Size Cutoff				
	None	1	2	3	4
I	21.4	16.3	11.7	9.7	8.2
II	26.5	20.4	14.8	12.2	10.2
III	30.0	23.9	17.8	14.8	12.2

[a]Commercial dry cleaning sector, payroll employees only, assuming projected worker displacements from Table 7-23. One-time (non-recurring) cost.

replaced retiring uncontrolled machines with controlled machines. Therefore, the output reduction used to estimate worker displacement and displacement costs would have occurred in the baseline over a 15 year time period (assuming all uncontrolled machines would have been replaced over this time period). Implicit in the estimated displacement costs is the assumption that this baseline output reduction--and corresponding reduction in employment--would have been accounted for through attrition rather than worker dislocation. In other words, the present value of foregone future displacement is assumed to be zero.

7.4 OWNERSHIP ADJUSTMENTS IN COMMERCIAL DRY CLEANING SECTOR

To estimate the financial impacts of the regulatory alternatives on businesses, estimating the number of firms they affect is necessary. As explained in Section 7.1, not all dry cleaning facilities would be affected by the regulatory alternatives being considered. Within the commercial dry cleaning sector itself, facilities that use solvents other than PCE and PCE facilities that are already in compliance with the alternatives (perhaps because of state regulations) will be unaffected by the NESHAP. This suggests that some firms will also be unaffected by the NESHAP.

Affected firms and affected facilities are one-and-the-same for single-plant firms (i.e., single-facility firms without an affected facility are themselves unaffected as business entities). In the case of multiplant firms, the number of affected firms is harder to estimate. A six-facility firm, for example, might have six affected facilities, six unaffected facilities, or any combination of both. In this analysis, it is assumed that the proportion of affected firms is identical to the proportion of affected facilities for all firm sizes. The estimated total number of affected firms is probably not too sensitive to this assumption because only 478 of 27,332 firms (1.75 percent) have more than two facilities (see Tables 5-2 and 5-4 in Section 5).

Estimates of affected firms are presented in Tables 7-25 through 7-28. Affected firms are categorized by size and baseline financial condition. Tables 7-25 and 7-26 present estimates of affected firms by size and condition assuming the financial scenario I relationship between firm size and condition, while Tables 7-27 and 7-28 are based on the the financial scenario II assumption.

The financial impact of a regulatory alternative on a firm depends largely on the number and type of affected facilities it owns, if any. Because large numbers of unaffected facilities and unaffected companies exist, many firms are not affected. Because most firms own a single facility and most facilities have a single machine, most affected firms are affected by the capital and annual operating costs of a single control device. Others, however, are financially affected by the capital and annual operating costs of two or more control devices because they own more than one machine in one or more facilities.

The facility weighted-average equipment prices and annual operating costs faced by firms in various receipts ranges under the three regulatory alternatives are presented in Table 7-29. Equipment costs are similar under all alternatives for firms under $100,000 annual receipts because they are essentially "single-machine firms." Firms over $100,000 would face equipment costs of $15,000 to $17,000, on average.

This analysis assumes that the owner(s) of an affected firm will try to pursue a course of action that maximizes the value of the firm, subject to

TABLE 7-25. NUMBER OF AFFECTED DRY CLEANING FIRMS BY SIZE AND BASELINE FINANCIAL CONDITION, FINANCIAL SCENARIO I--REGULATORY ALTERNATIVES I AND II

Receipts Range ($000)	Baseline Financial Condition Total	Below Average	Average	Above Average
<25	3,188	3,188	0	0
25-50	1,684	58	1,626	0
50-75	772	0	772	0
75-100	660	0	660	0
100-250	1,620	0	1,059	561
250-500	680	0	0	680
>500	376	0	0	376
Total	8,980	3,246	4,117	1,617

[a]Number of affected firms in each receipts range computed based on the assumption that the proportion of affected firms is identical to the proportion of affected facilities (see Tables 2-2, 5-2, and 7-2).

[b]Assumes a positive relationship between firm size and baseline financial condition (Financial Scenario I). The share of affected firms in below-average, average, and above-average financial condition in each receipts range is based on the distribution reported in Table 5-5 for all firms.

TABLE 7-26. NUMBER OF AFFECTED DRY CLEANING FIRMS BY SIZE AND BASELINE FINANCIAL CONDITION, FINANCIAL SCENARIO I--REGULATORY ALTERNATIVE III

Receipts Range	Baseline Financial Condition			
($000)	Total	Below Average	Average	Above Average
<25	3,396	3,396	0	0
25-50	1,896	65	1,831	0
50-75	956	0	956	0
75-100	876	0	876	0
100-250	2,188	0	1,430	758
250-500	920	0	0	920
>500	512	0	0	512
Total	10,744	3,461	5,093	2,190

[a]Number of affected firms in each receipts range computed based on the assumption that the proportion of affected firms is identical to the proportion of affected facilities (see Tables 2-2, 5-2, and 7-3).

[b]Assumes a positive relationship between firm size and baseline financial condition (Financial Scenario I). The share of affected firms in below-average, average, and above-average financial condition in each receipts range is based on the distribution reported in Table 5-5 for all firms.

TABLE 7-27. NUMBER OF AFFECTED DRY CLEANING FIRMS BY SIZE AND BASELINE FINANCIAL CONDITION, FINANCIAL SCENARIO II--REGULATORY ALTERNATIVES I AND II

Receipts Range	Baseline Financial Condition			
($000)	Total	Below Average	Average	Above Average
<25	3,188	797	1,594	797
25-50	1,684	421	842	421
50-75	772	193	386	193
75-100	660	165	330	165
100-250	1,620	405	810	405
250-500	680	170	340	170
>500	376	94	188	94
Total	8,980	2,245	4,490	2,245

[a]Number of affected firms in each receipts range computed based on the assumption that the proportion of affected firms is identical to the proportion of affected facilities (see Tables 2-2, 5-2, and 7-2).

[b]Assumes that 25 percent of affected firms are below-average, 50 percent of affected firms are average, and 25 percent of affected firms are above-average financial condition in the baseline (Financial Scenario II).

TABLE 7-28. NUMBER OF AFFECTED DRY CLEANING FIRMS BY SIZE AND BASELINE FINANCIAL CONDITION, FINANCIAL SCENARIO II--REGULATORY ALTERNATIVE III

Receipts Range ($000)	Baseline Financial Condition			
	Total	Below Average	Average	Above Average
<25	3,396	849	1,698	849
25-50	1,896	474	948	474
50-75	956	239	477	239
75-100	876	219	438	219
100-250	2,188	547	1,094	547
250-500	920	230	460	230
>500	512	128	257	128
Total	10,744	2,686	5,372	2,686

[a]Number of affected firms in each receipts range computed based on the assumption that the proportion of affected firms is identical to the proportion of affected facilities (see Tables 2-2, 5-2, and 7-3).

[b]Assumes that 25 percent of affected firms are below-average, 50 percent of affected firms are average, and 25 percent of affected firms are above-average financial condition in the baseline (Financial Scenario II).

TABLE 7-29. INSTALLED PRICE OF CONTROL EQUIPMENT AND ANNUAL OPERATING COST, BY REGULATORY ALTERNATIVE AND SIZE OF FIRM[a]

Receipts Range ($000)	Regulatory Alternative	Equipment Price ($)	Annual Operating Cost ($)
<25	I	7,515	338
	II	6,682	1,789
	III	6,701	1,838
25-50	I	7,302	272
	II	6,613	1,471
	III	6,651	1,580
50-75	I	6,804	186
	II	6,451	789
	III	6,550	1,121
75-100	I	7,334	137
	II	6,780	1,098
	III	6,829	1,447
>100	I	16,538	-99
	II	15,222	1,804
	III	15,274	2,745

[a]All costs are weighted-averages across affected facilities and firms. Costs are computed using the distribution of facilities and firms reported in Tables 7-2, 7-3, and 7-25 through 7-28 and the costs reported in Tables 7-6 and 7-7.

uncertainties about actual costs of compliance and the behavior of other firms. The owners' response options include

- closing the facility,
- bringing the facility into compliance with the regulation, and
- selling the facility.

If the expected post-compliance value of an affected facility is negative (or simply lower than the "scrap value" of the facility), the owner of the plant will likely close it. If the expected post-compliance value is positive and greater than the scrap value, the owner will <u>either</u> bring it into compliance <u>or</u> sell it to another firm that will do so.

Whether the firm keeps or sells the facility depends on the financial condition of the firm. If the firm has and/or can borrow sufficient funds to make a facility compliant, it keeps the facility. If instead the firm has inadequate funds and debt capacity, it sells or closes the facility. In this analysis, it is assumed that firms in below-average financial condition cannot borrow money. These firms either have sufficient cash and purchase the control equipment, or they have insufficient funds and sell the facility to another firm.

Firms in average or above-average financial condition are assumed to borrow the required funds, though possibly some of them will use internal funds instead of or in conjunction with borrowing. It is assumed that seven-year bank notes at 11 percent interest are available to above-average firms, and that similar notes at 11.5 percent interest are available to average firms. The annual amortized (principal plus interest) payments on these notes--available only to firms in above-average or average financial condition--are presented in Table 7-30. Just as the control equipment costs vary little across firms under $100,000 annual receipts, so do the note payments. Note payments for firms in average and above-average financial condition are very similar because the interest rates are within one-half percent of one another. Even though lenders are assumed to view firms in below-average financial condition as much riskier than those in average financial condition, they are assumed to view above-average firms as only slightly less risky than average firms.

Firms that purchase control devices with cash have high initial cash outlays but low recurring annual expenses. Firms that purchase control devices with borrowed funds have low initial cash outlays but higher recurring annual expenses. The initial cash outlays and recurring annual expenses incurred by firms of different types and sizes are presented in Table 7-31. As described above, firms in average and above-average financial condition can borrow funds and thus don't have to use cash to purchase control equipment. Their recurring annual expenses, however, include interest and principal payments on seven-year notes in addition to annual operating costs. Firms in

TABLE 7-30. ANNUAL PRINCIPAL AND INTEREST PAYMENTS ON A SEVEN-YEAR NOTE BY REGULATORY ALTERNATIVE, FIRM SIZE, AND INTEREST RATE ($)[a]

	Regulatory Alternative		
	I	II	III
<$25,000 Annual Receipts			
11.0% note	1,595	1,418	1,422
11.5% note	1,621	1,441	1,445
$25,000-50,000 annual receipts			
11.0% note	1,550	1,403	1,412
11.5% note	1,575	1,426	1,434
$50,000-$75,000 annual receipts			
11.0% note	1,444	1,369	1,390
11.5% note	1,467	1,391	1,473
$75,000-$100,000 annual receipts			
11.0% note	1,556	1,439	1,449
11.5% note	1,582	1,462	1,473
>$100,000 annual receipts			
11.0% note	3,510	3,231	3,241
11.5% note	3,567	3,283	3,294

[a]Seven-year notes at 11.5 percent interest available to firms in average financial condition; 11 percent notes available to above-average firms. Costs are computed using data from Table 7-29.

TABLE 7-31. INITIAL CASH OUTLAY REQUIREMENT[a] AND RECURRING ANNUAL EXPENSES[b] BY FIRM SIZE, FINANCIAL CONDITION, AND REGULATORY ALTERNATIVE ($)

Receipts Range ($000)	Regulatory Altern-atives	Firm Financial Condition					
		Below Average		Average		Above Average	
		Cash Outlay	Annual Expense	Cash Outlay	Annual Expense	Cash Outlay	Annual Expense
<25	I	7,515	338	0	1,959	0	1,933
	II	6,682	1,789	0	3,230	0	3,207
	III	6,701	1,838	0	3,283	0	3,260
25-50	I	7,302	272	0	1,847	0	1,822
	II	6,613	1,471	0	2,897	0	2,874
	III	6,651	1,580	0	3,015	0	2,992
50-75	I	6,804	186	0	1,653	0	1,630
	II	6,451	798	0	2,189	0	2,167
	III	6,550	1,121	0	2,533	0	2,511
75-100	I	7,334	137	0	1,719	0	1,693
	II	6,780	1,098	0	2,560	0	2,537
	III	6,829	1,447	0	2,920	0	2,896
>100	I	16,538	-99	0	3,467	0	3,411
	II	15,222	1,804	0	5,087	0	5,035
	III	15,274	2,745	0	6,039	0	5,987

[a]Initial cash outlay equals cost of control equipment for firms in below-average financial condition assuming they are unable to debt finance; zero for average and above-average firms assuming debt financing (see Table 7-29).

[b]Recurring annual expenses include annual operating cost (all firms) (see Table 7-29) plus seven-year note annual principal and interest payment for average and above-average firms (see Table 7-30).

below-average financial condition have large cash requirements because they cannot borrow money but have only operating costs as recurring annual expenses.

The firm financial impacts of the regulatory alternatives are assessed by

- computing post-compliance *pro forma* income statements and balance sheets of firms of different sizes and financial conditions;
- computing the implied post-compliance financial ratios of these firms; and
- comparing baseline and post-compliance statements and ratios to discern clearly adverse financial impacts.

The *pro forma* financial statements of affected firms are presented in Appendix A. In all cases, revenues are assumed to be unaffected by the regulatory alternatives. The following adjustments are made to statements of firms of all sizes in below-average financial condition. In the annual income statement, other expenses and taxes increase by the amount of the recurring compliance costs, and net profits fall by the same amount. In the balance sheet, cash declines by the price of the control equipment and fixed assets rise by the same amount. These firms have simply "traded" cash for control devices in an accounting sense, so total assets and total liabilities remain unchanged. Because, in fact, none of the firms in below-average financial condition *have* adequate cash to purchase control devices, their failures will be caused by capital availability constraints (see discussion below). The liabilities side of the balance sheet is unaffected because the firms enter into no new legal obligations.

The following adjustments are made to statements of firms of all sizes in average and above-average financial condition. In the annual income statement, other expenses and taxes increase by the amount of the recurring compliance costs and the annual note payments (see Table 7-31), and net profits fall by the same amount. In the balance sheet, cash is unaffected because these firms borrow money for purchasing control equipment. Fixed and total assets increase by the value (price) of the control equipment. On the liabilities side of the balance sheet, total liabilities and net worth have to increase by the same amount. Both current and non-current liabilities increase. Notes payable (this year) increase by the amount of the annual principal and interest payment (from Table 7-30). Non-current liabilities (which include bank notes) increase by the loan amount (control equipment price) less the amount of principal payable this year (which is part of the increase in notes payable). Because the assets of the firm have increased by the value (price) of the control equipment but the liabilities have increased by that amount plus interest costs, the net worth of the firm declines somewhat. Financial ratios commonly used to measure financial viability are described in Table 7-32.

The post-compliance (and baseline reference) financial ratios of affected firms of different sizes and financial types derived from the *pro forma* statements in Appendix A are presented in Tables 7-33 through 7-37. Financial ratio impacts on firms with annual receipts below $25,000 are presented first. All three regulatory alternatives will likely have substantial adverse impacts on firms of this size, regardless of baseline financial condition. The impacts of the alternatives on firms in below-average and average financial condition are most apparent, but impacts even on above-average firms may be substantial. The smallest-size, above-average firms remain profitable under Regulatory Alternative I but may be unprofitable under Alternatives II and III. Note that the debt ratios of average and above-average firms increase very substantially because they borrow funds to purchase control equipment.

The debt ratio of below-average firms is unaffected because they must rely on cash rather than borrowed funds to purchase equipment, but liquidity impacts are substantial.

Financial impacts diminish as firm size increases. Although the baseline financial ratios of firms of all sizes in any given financial condition are the same, the magnitudes of their flows and balances vary by size. For example, even though firms of all sizes in average financial condition have the same baseline profit-to-sales ratio (7.0), a firm with twice the sales receipts of another has twice the annual profits as well. Because the cost of purchasing and operating control equipment is about the same for most firms under $100,000, the financial impacts are greater for the smaller firms.

TABLE 7-32. KEY FINANCIAL RATIOS

LIQUIDITY	Current Ratio: total current assets divided by total current liabilities. Measures the degree to which current liabilities—legal obligations coming due within the year—are covered by current assets—assets that can be readily converted into cash. Post-compliance ratios significantly below 0.8—the lower quartile (LQ) ratio for dry cleaning firms (firms) in the Dun and Bradstreet (D&B) data base—are considered indicators of failure.
ACTIVITY	Fixed Asset Turnover Ratio: annual sales divided by fixed assets. Measures how efficiently the firm uses its plant and equipment to generate sales. Post-compliance ratios significantly below 2.30—the LQ ratio for firms in the D&B data base—are considered indicators of failure.
LEVERAGE	Debt Ratio: total liabilities divided by total liabilities plus net-worth. Measures the legal debt burden of the firm. Post-compliance ratios significantly above 60 percent—the LQ ratio for firms in the D&B data base—are considered indicators of capital availability constraints and thus business failure.
PROFITABILITY	Profit-to-Sales Ratio: annual net profit divided by annual sales, expressed as a percentage. Measures the excess of annual revenues over annual accounting costs of doing business. Post-compliance ratios significantly below one percent—the LQ ratio for firms in the D&B data base—are considered indicators of business failure.
	Profit-to-Assets Ratio: annual net profit divided by total assets, expressed as a percentage. Measures the return to current and non-current assets. Post-compliance ratios significantly below 1.4 percent—the LQ ratio for firms in the D&B data base—are considered indicators of business failure.
	Profit-to-Net-Worth Ratio: annual net profit divided by the net-worth of the firm, expressed as a percentage. Measures the accounting return to the owners of the firm. Post-compliance ratios significantly below 3.6 percent—the LQ ratio for firms in the D&B data base—are considered indicators of business failure.

Source: Van Horne, 1980.

TABLE 7-33. BASELINE AND AFFECTED FINANCIAL RATIOS: <$25,000 FIRM RECEIPTS[a]

	Baseline Financial Condition		
	Below Average	Average	Above Average
Liquidity			
current ratio (times)			
Baseline	0.80	1.73	5.10
RA I	-1.64	0.92	1.16
RA II	-1.37	0.97	1.27
RA III	-1.38	0.97	1.27
Activity			
fixed asset turnover ratio (times)			
Baseline	2.30	5.56	7.54
RA I	1.17	1.66	1.80
RA II	1.23	1.80	1.96
RA III	1.23	1.79	1.96
Leverage			
debt ratio (percent)			
Baseline	60	46	15
RA I	60	77	64
RA II	60	75	62
RA III	60	75	62
Profitability			
profit to sales (percent)			
Baseline	1.0	7.0	13.0
RA I	-0.9	-4.0	2.1
RA II	-9.1	-11.2	-5.1
RA III	-9.4	-11.5	-5.4
profit to assets (percent)			
Baseline	1.4	14.5	32.5
RA I	-1.3	-4.5	2.6
RA II	-13.0	-13.0	-6.5
RA III	-13.4	-13.4	-6.9
Profit to net-worth (percent)			
Baseline	3.5	26.8	38.2
RA I	-3.2	-19.1	7.2
RA II	-32.4	-51.5	-17.0
RA III	-33.4	-52.9	-18.0

[a]Baseline ratios are computed using data from Duns Analytical Services (1990). Ratios under each Regulatory Alternative are computed using cost data in Table 7-31 and data from Duns Analytical Services (1990).

TABLE 7-34. BASELINE AND AFFECTED FINANCIAL RATIOS: $25,000-50,000 FIRM RECEIPTS[a]

	Baseline Financial Condition		
	Below Average	Average	Above Average
Liquidity			
current ratio (times)			
Baseline	0.80	1.73	5.10
RA I	-0.24	1.26	2.09
RA II	-0.14	1.29	2.21
RA III	-0.14	1.29	2.21
Activity			
fixed asset turnover ratio (times)			
Baseline	2.30	5.56	7.54
RA I	1.63	2.78	3.20
RA II	1.67	2.92	3.38
RA III	1.67	2.91	3.37
Leverage			
debt ratio (percent)			
Baseline	60	46	15
RA I	60	64	45
RA II	60	62	43
RA III	60	63	43
Profitability			
profit to sales (percent)			
Baseline	1.0	7.0	13.0
RA I	0.3	2.4	8.5
RA II	-2.6	-0.1	5.9
RA III	-2.9	-0.4	5.6
profit to assets (percent)			
Baseline	1.4	14.5	32.5
RA I	0.5	3.7	14.7
RA II	-3.8	-0.2	10.5
RA III	-4.1	-0.7	10.0
Profit to net-worth (percent)			
Baseline	3.6	26.8	38.2
RA I	1.2	10.2	26.6
RA II	-9.4	-0.6	18.4
RA III	-10.4	-1.8	17.5

[a]Baseline ratios are computed using data from Duns Analytical Services (1990). Ratios under each Regulatory Alternative are computed using cost data in Table 7-31 and data from Duns Analytical Services (1990).

TABLE 7-35. BASELINE AND AFFECTED FINANCIAL RATIOS: $50,000-75,000 FIRM RECEIPTS[a]

	Baseline Financial Condition		
	Below Average	Average	Above Average
Liquidity			
current ratio (times)			
Baseline	0.80	1.73	5.10
RA I	0.22	1.43	2.81
RA II	0.25	1.44	2.88
RA III	0.24	1.44	2.86
Activity			
fixed asset turnover ratio (times)			
Baseline	2.30	5.56	7.54
RA I	1.87	3.55	4.27
RA II	1.89	3.62	4.37
RA III	1.88	3.60	4.34
Leverage			
debt ratio (percent)			
Baseline	60	46	15
RA I	60	57	34
RA II	60	57	34
RA III	60	57	34
Profitability			
profit to sales (percent)			
Baseline	1.0	7.0	13.0
RA I	0.7	4.5	10.6
RA II	-0.2	3.7	9.8
RA III	-0.7	3.2	9.3
profit to assets (percent)			
Baseline	1.4	14.5	32.5
RA I	1.0	7.8	21.1
RA II	-0.3	6.5	19.7
RA III	-1.0	5.6	18.6
Profit to net-worth (percent)			
Baseline	3.6	26.8	38.2
RA I	2.6	18.2	32.1
RA II	-0.7	14.9	29.7
RA III	-2.4	12.9	28.1

[a]Baseline ratios are computed using data from Duns Analytical Services (1990). Ratios under each Regulatory Alternative are computed using cost data in Table 7-31 and data from Duns Analytical Services (1990).

TABLE 7-36. BASELINE AND AFFECTED FINANCIAL RATIOS: $75,000–100,000 FIRM RECEIPTS[a]

	Baseline Financial Condition		
	Below Average	Average	Above Average
Liquidity			
current ratio (times)			
Baseline	0.80	1.73	5.10
RA I	0.35	1.49	3.14
RA II	0.38	1.50	3.23
RA III	0.38	1.50	3.22
Activity			
fixed asset turnover ratio (times)			
Baseline	2.30	5.56	7.54
RA I	1.95	3.87	4.74
RA II	1.98	3.97	4.88
RA III	1.97	3.96	4.87
Leverage			
debt ratio (percent)			
Baseline	60	46	15
RA I	60	55	31
RA II	60	54	30
RA III	60	55	30
Profitability			
profit to sales (percent)			
Baseline	1.0	7.0	13.0
RA I	0.9	5.2	11.2
RA II	-0.2	4.3	10.3
RA III	-0.5	3.9	9.9
profit to assets (percent)			
Baseline	1.4	14.5	32.5
RA I	1.2	9.2	23.4
RA II	-0.2	7.7	21.8
RA III	-0.8	7.0	21.0
Profit to net-worth (percent)			
Baseline	3.6	26.8	38.2
RA I	3.1	20.5	33.8
RA II	-0.6	16.9	31.0
RA III	-1.9	15.4	29.9

[a]Baseline ratios are computed using data from Duns Analytical Services (1990). Ratios under each Regulatory Alternative are computed using cost data in Table 7-31 and data from Duns Analytical Services (1990).

TABLE 7-37. BASELINE AND AFFECTED FINANCIAL RATIOS: >$100,000 FIRM RECEIPTS[a]

	Baseline Financial Condition		
	Below Average	Average	Above Average
Liquidity			
current ratio (times)			
Baseline	0.80	1.73	5.10
RA I	0.54	1.58	3.75
RA II	0.56	1.59	3.83
RA III	0.56	1.59	3.83
Activity			
fixed asset turnover ratio (times)			
Baseline	2.30	5.56	7.54
RA I	2.09	4.45	5.63
RA II	2.10	4.52	5.75
RA III	2.10	4.52	5.74
Leverage			
debt ratio (percent)			
Baseline	60	46	15
RA I	60	51	25
RA II	60	51	24
RA III	60	51	24
Profitability			
profit to sales (percent)			
Baseline	1.0	7.0	13.0
RA I	1.0	6.1	12.1
RA II	0.5	5.6	11.6
RA III	0.3	5.2	11.4
profit to assets (percent)			
Baseline	1.4	14.5	32.5
RA I	1.5	11.5	27.1
RA II	0.7	10.7	26.3
RA III	0.4	10.2	25.8
Profit to net-worth (percent)			
Baseline	3.6	26.8	38.2
RA I	3.7	23.7	36.0
RA II	1.8	21.9	34.7
RA III	0.9	20.9	33.9

[a]Baseline ratios are computed using data from Duns Analytical Services (1990). Ratios under each Regulatory Alternative are computed using cost data in Table 7-31 and data from Duns Analytical Services (1990).

To illustrate, consider the impacts of Regulatory Alternative II on profit-to-net worth of two firms in average financial condition--one with annual receipts of $40,545 and the other of $93,829. Even though the sales of the latter are 2.3 times those of the former, the cost of purchasing and operating the control device is about the same for both (see Table 7-29). The baseline profit-to-net worth ratio is 26.8 percent for both firms, but the profits and net worth of the larger firm are 2.3 times higher than those of the smaller firm. Thus, Regulatory Alternative II reduces estimated profitability of the smaller firm to -0.6 percent but reduces estimated profitability of the larger firm to 16.9 percent.

Once firm size reaches $75-100,000 in annual receipts, firms in average and above-average financial condition are affected but remain reasonably profitable, liquid, and properly leveraged under all three regulatory alternatives. The projected financial impacts on even the largest firms in below-average financial condition, however, remain significant. Table 7-37 indicates that large, below-average firms have estimated baseline profitability ratios (to sales) of 1.0 percent. Regulatory Alternatives II and III reduce profitability to 0.5 percent and 0.3 percent, respectively. Regulatory Alternative I has a small profitability impact because operating costs of the control capital are low (see Table 7-31). The below-average model firm's estimated current ratio falls significantly from 0.80 to 0.54, however, because control capital costs are high relative to cash balances.

Projected financial failures of businesses under the financial scenario I are presented in Table 7-38. Business failures are thus dissolutions of legal entities. In this context, businesses fail either because they do not have and are unable to borrow sufficient funds to purchase control equipment for the dry cleaning facility(ies) they own or because after making the dry cleaning facility(ies) they own compliant, revenues would be insufficient to meet legal financial obligations. Again, business failures are not necessarily associated with facility closures. Economically viable compliant facilities may be sold rather than closed, because they still generate revenues in excess of variable costs. Because the excess revenues may be insufficient to pay existing and new legal obligations of some firms, however, the facility may be sold to another, more financially viable firm.

TABLE 7-38. PROJECTED FINANCIAL FAILURES OF COMMERCIAL DRY CLEANING FIRMS BY REGULATORY ALTERNATIVE AND SIZE CUTOFF, FINANCIAL SCENARIO I (NUMBER OF FIRMS AND PERCENT)[a]

Regulatory Alternative	Size Cutoff ($000)				
	None	<25,000	<50,000	<75,000	<100,000
I	3,246 11.9%	58 0.2%	0 0%	0 0%	0 0%
II	4,872 17.8	1,684 6.2%	0 0%	0 0%	0 0%
III	5,292 19.4%	1,896 6.9%	0 0%	0 0%	0 0%

[a]Percentage of all dry cleaning firms in U.S. in 1991. Assumes full absorbtion of compliance costs. Financial failure is defined as (1) the lack of sufficient funds or inability to borrow sufficient funds to purchase the required control equipment or (2) insufficient revenues to meet legal financial obligations due to increased costs of production.

Under financial scenario I that most firms in below-average condition have annual receipts under $25,000 and all have receipts under $50,000, the number of financial failures assuming no size cutoff ranges from 3,246 to 5,292, depending on the Regulatory Alternative. Projected failures are substantially reduced with a $25,000 receipts cutoff, and zero with a $50,000 or higher cutoff.

Projected financial failures under financial scenario II with no systematic relationship between firm size and financial condition are presented in Table 7-39. While projected failures are only 11 percent to 17 percent higher (depending on the Regulatory Alternative) under the financial scenario II assumption assuming no size cutoff, they are substantially higher under any positive size cutoff.

TABLE 7-39. PROJECTED FINANCIAL FAILURES OF COMMERCIAL DRY CLEANING FIRMS BY REGULATORY ALTERNATIVE AND SIZE CUTOFF, FINANCIAL SCENARIO II (NUMBER OF FIRMS AND PERCENT)[a]

Regulatory Alternative	Size Cutoff ($000)				
	None	<25,000	<50,000	<75,000	<100,000
I	3,839 14.0%	1,448 5.3%	1,027 3.8%	834 3.1%	669 2.4%
II	5,478 20.0%	2,290 8.4%	1,027 3.8%	834 3.1%	669 2.4%
III	6,183 22.6%	2,787 10.2%	1,365 5.0%	1,126 4.1%	905 3.3%

[a]Percentage of all dry cleaning firms in U.S. in 1991. Assumes full absorption of compliance costs. Financial failure is defined as (1) the lack of sufficient funds or inability to borrow sufficient funds to purchase the required control equipment or (2) insufficient revenues to meet legal financial obligations due to increased costs of production.

The effects of alternative size cut-offs on business failures are illustrated graphically in Figures 7-3 through 7-8. These figures also illustrate the types of estimated financial failures. Businesses in poor financial condition are estimated to fail unless they have sufficient cash to purchase required control equipment (because they are assumed to be unable to borrow money). Failures of this type are referred to as capital availability failures. Businesses in average or better financial condition can borrow money but still fail if expected revenues are insufficient to cover baseline plus recurring regulatory costs--loan payments, recurring fixed control costs, and variable control costs. These failures are referred to as profitability failures.

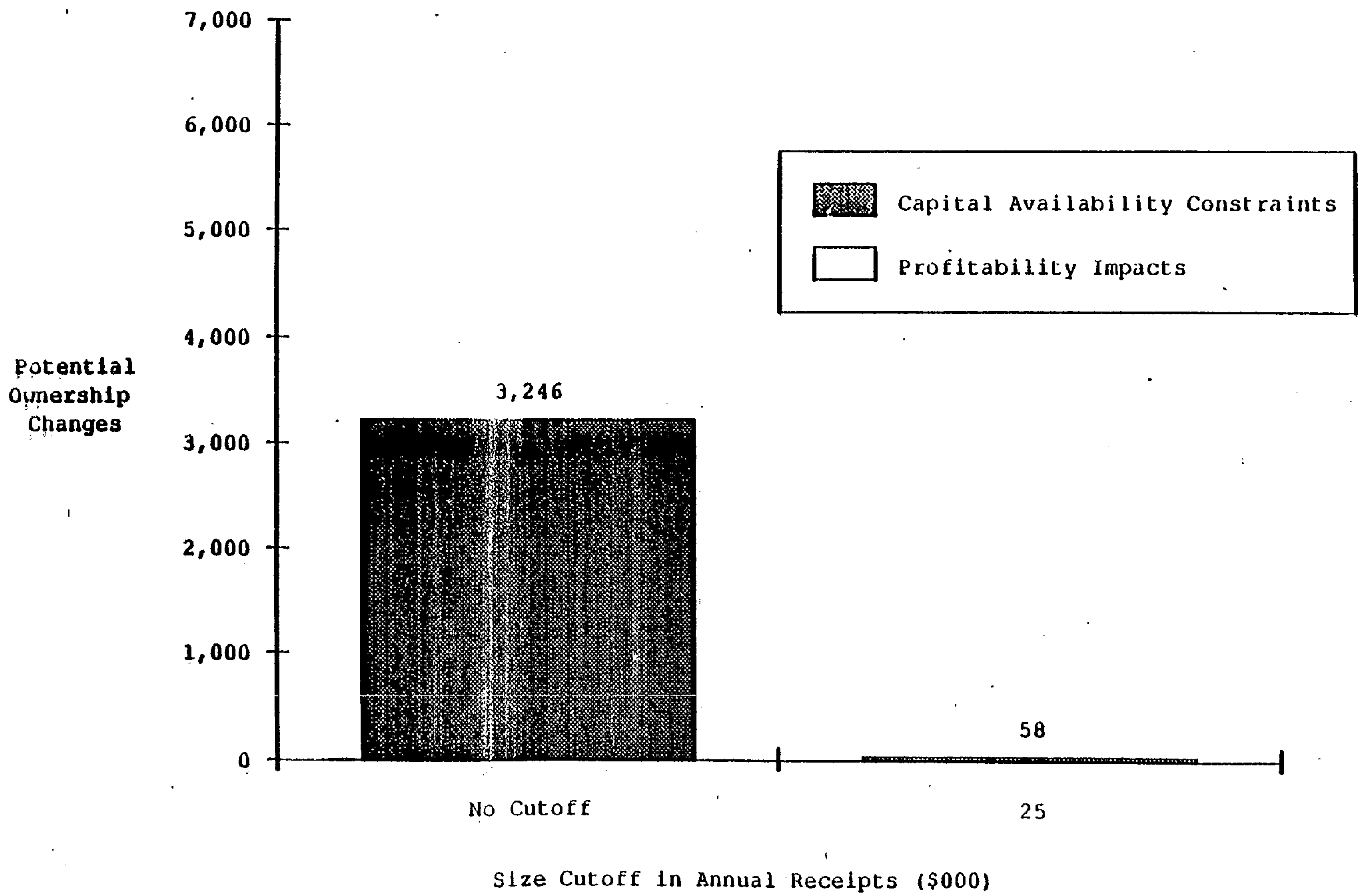


Figure 7-3. Capital Availability and Profitability Impacts, Financial Scenario I--Regulatory Alternative I

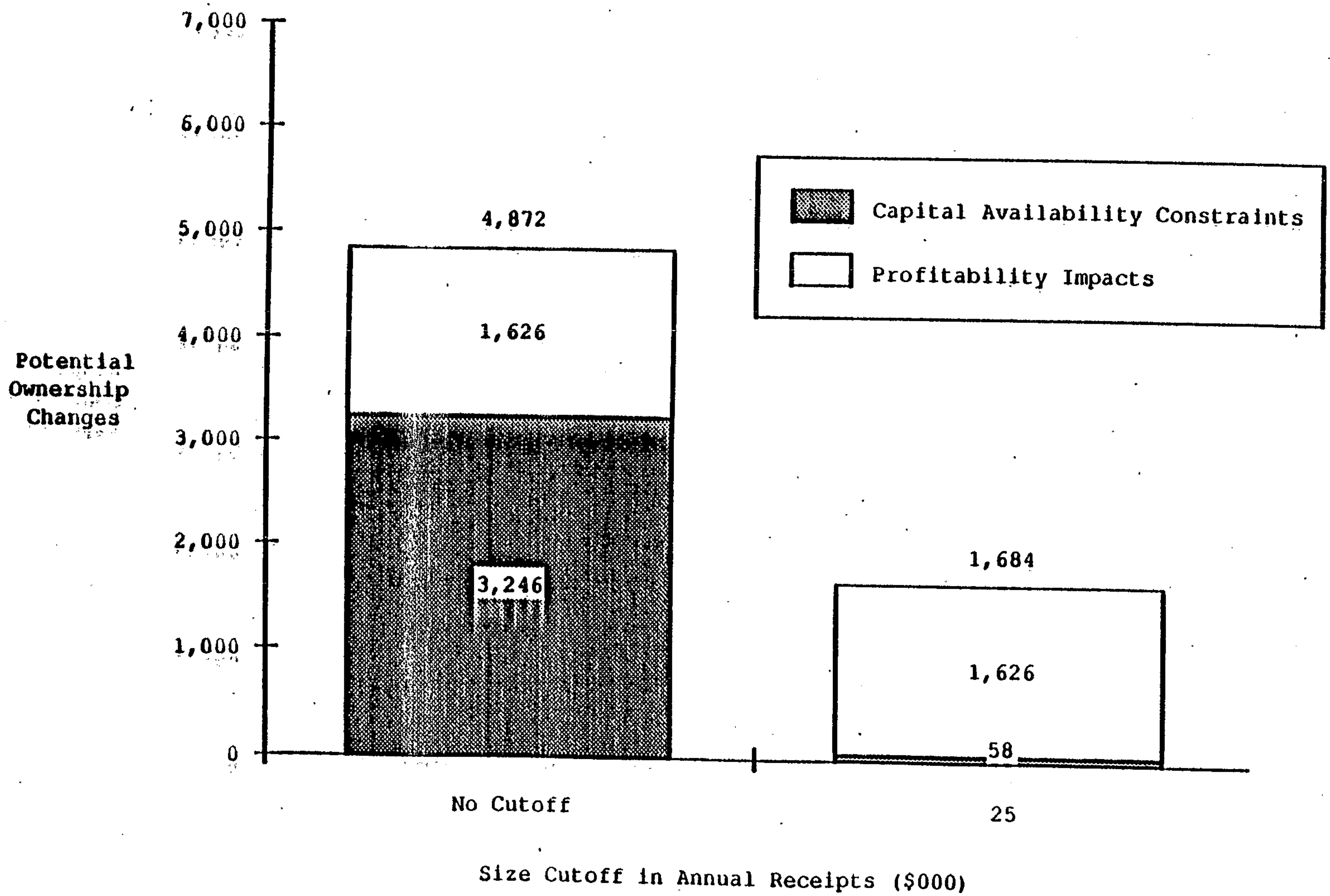


Figure 7-4. Capital Availability and Profitability Impacts, Financial Scenario I--Regulatory Alternative II

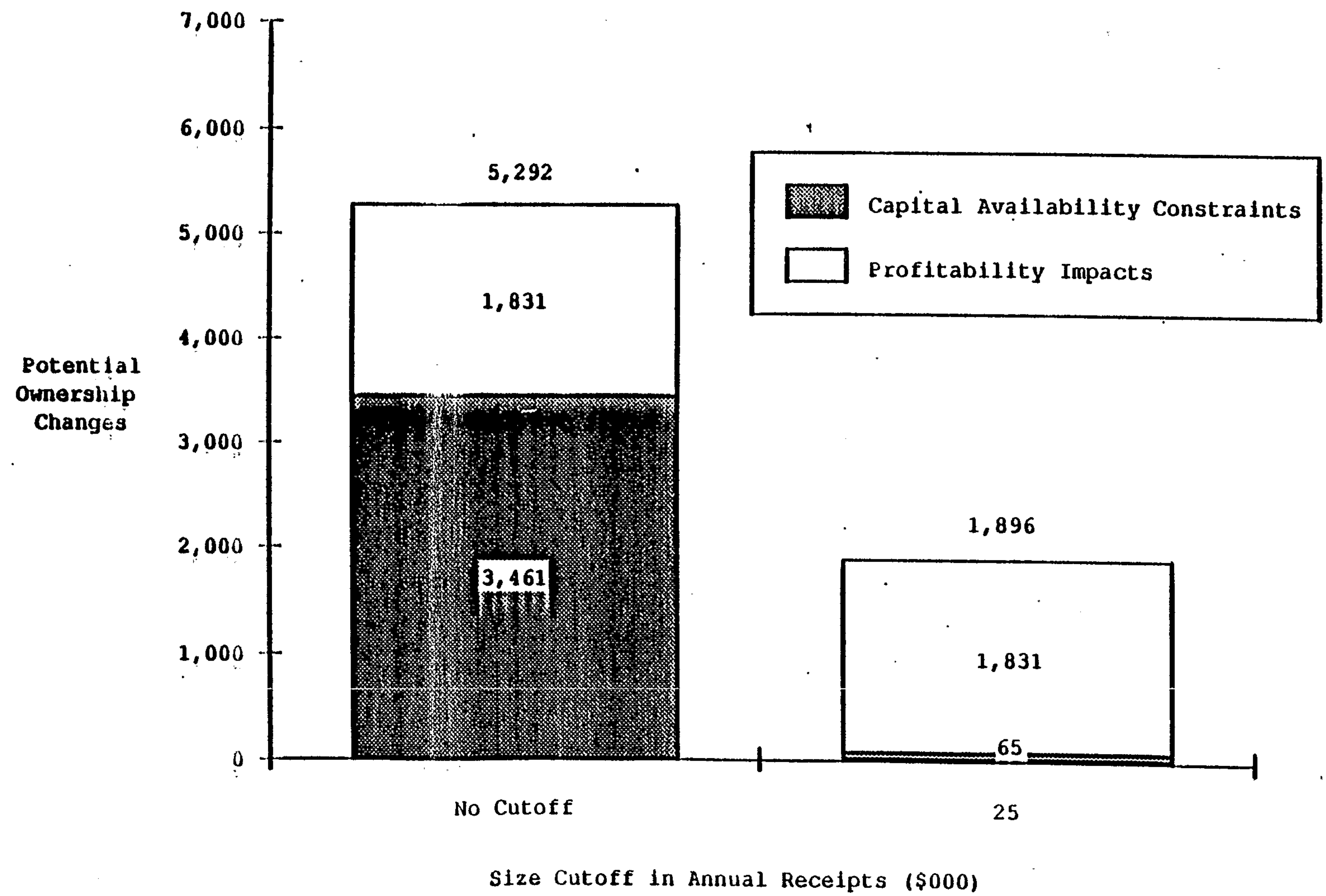


Figure 7-5. Capital Availability and Profitability Impacts, Financial Scenario I--Regulatory Alternative III

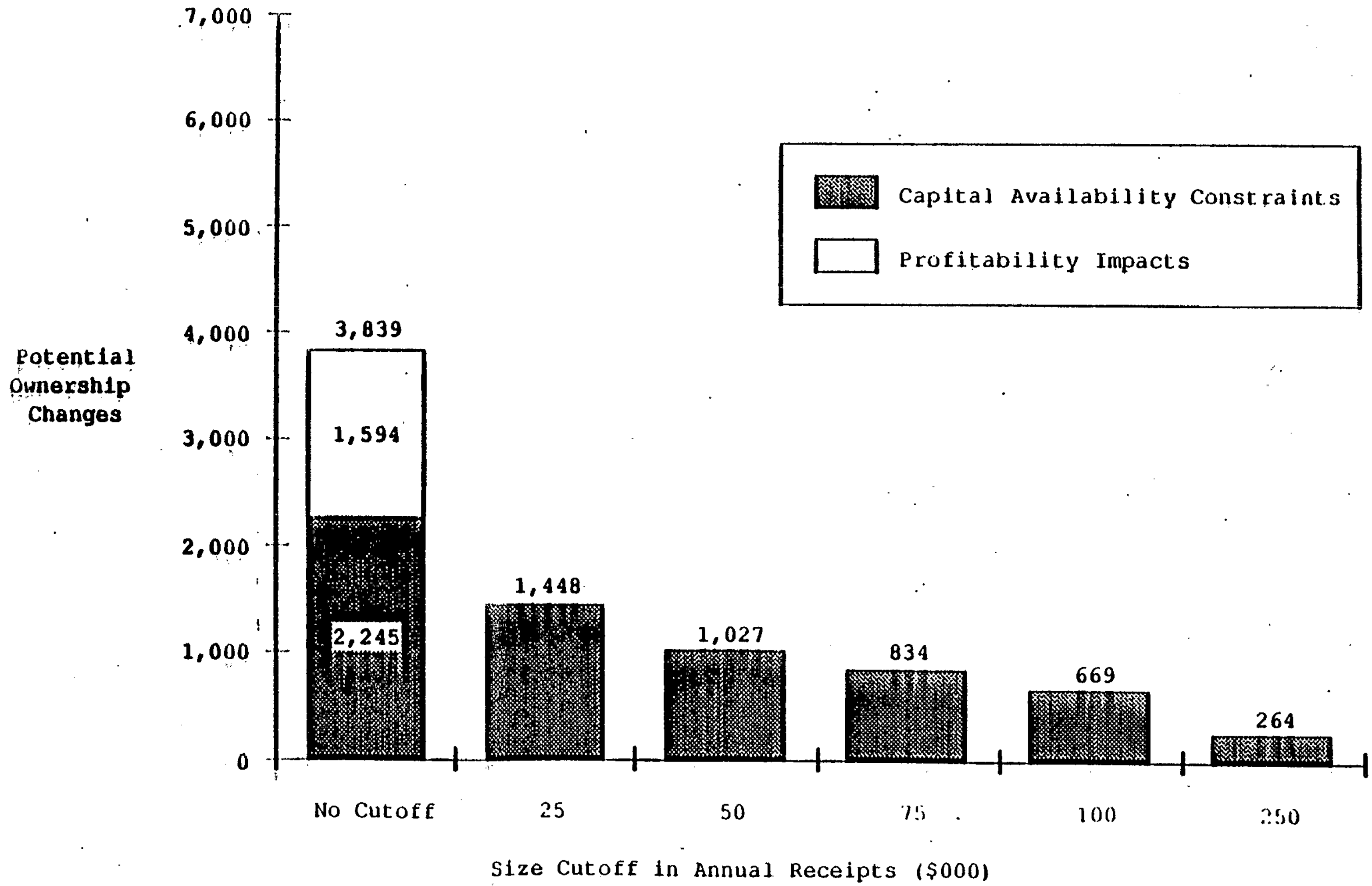


Figure 7-6. Capital Availability and Profitability Impacts, Financial Scenario II--Regulatory Alternative I

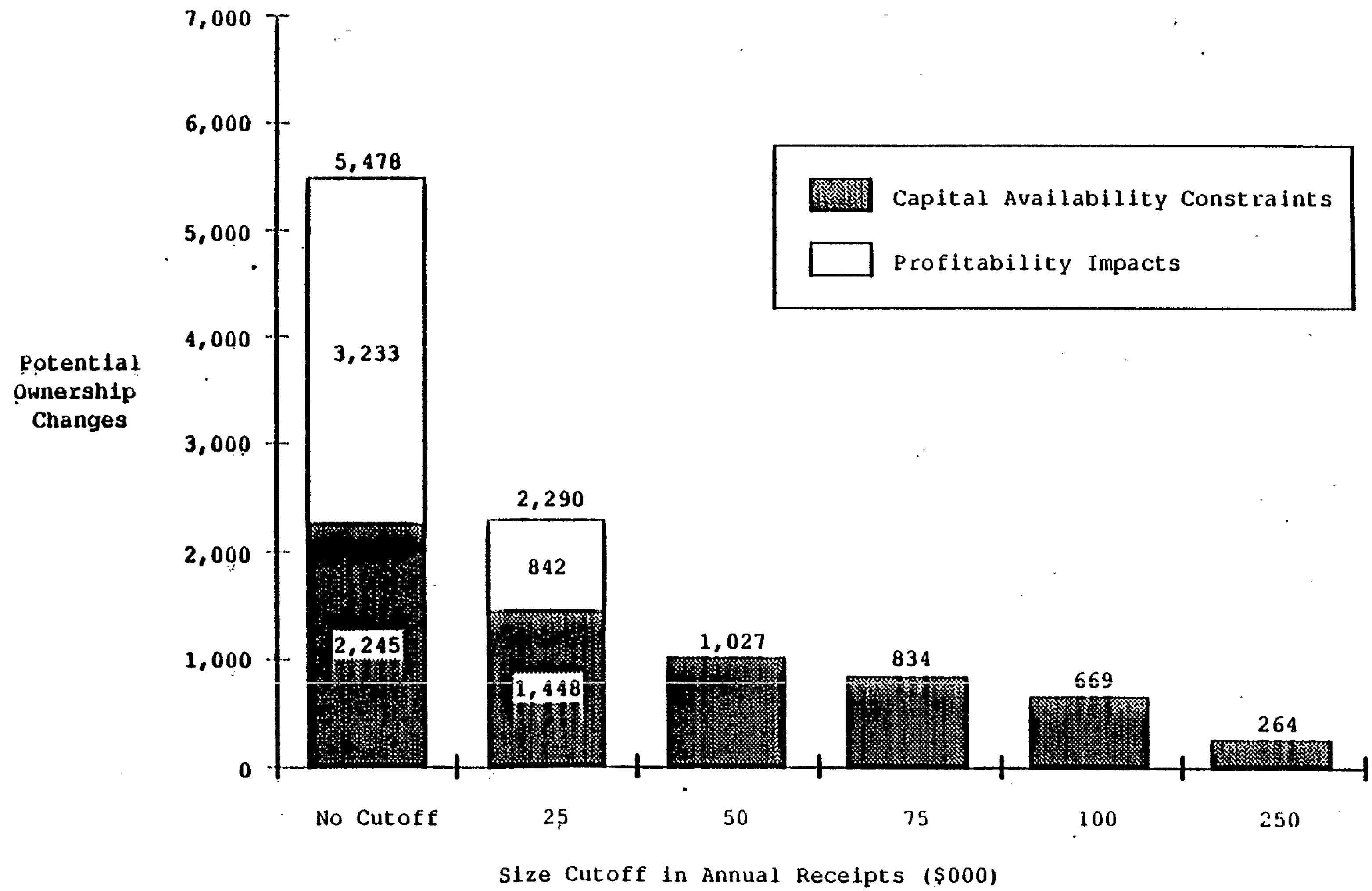


Figure 7-7. Capital Availability and Profitability Impacts, Financial Scenario II--Regulatory Alternative II

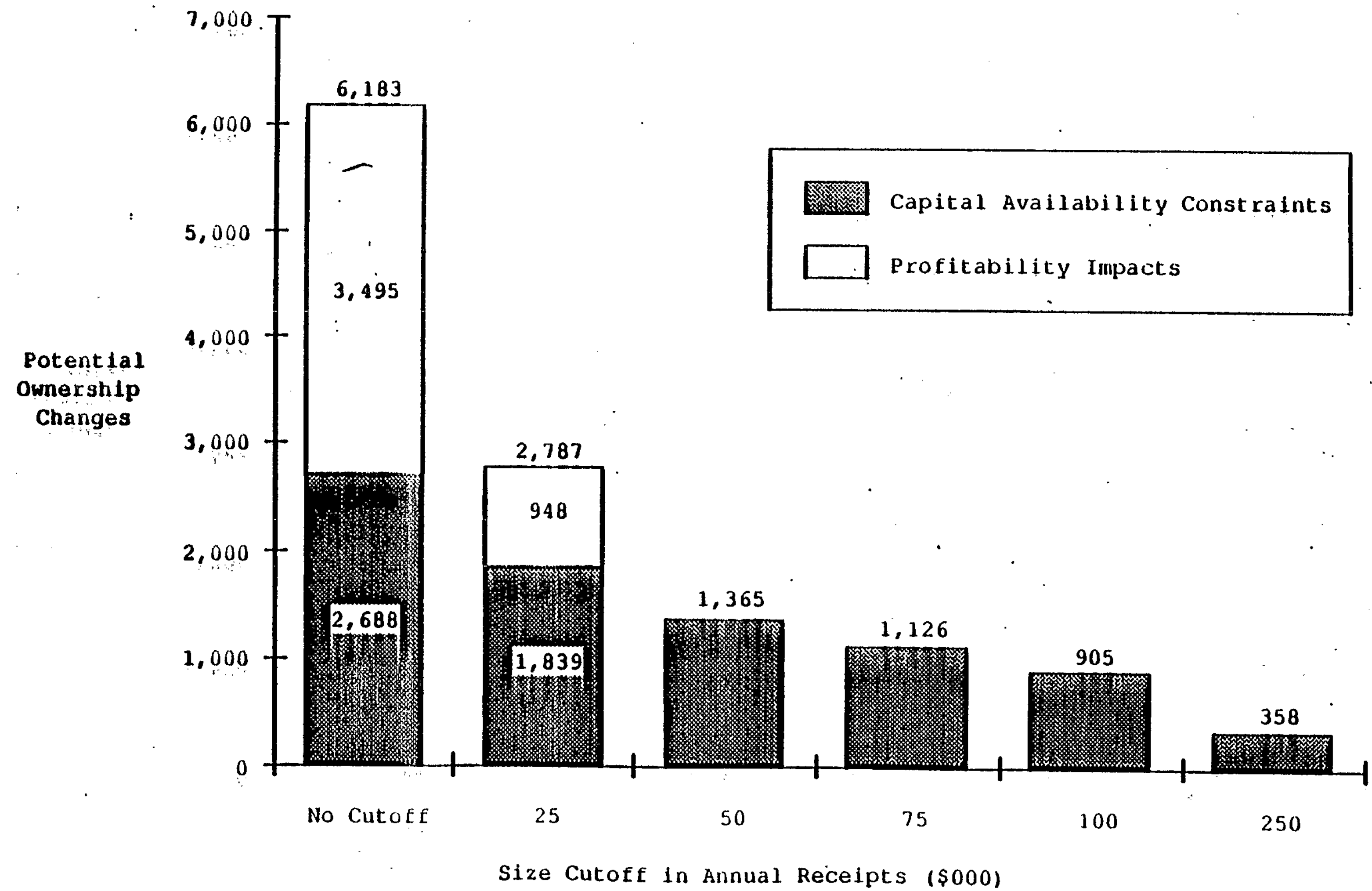


Figure 7-8. Capital Availability and Profitability Impacts, Financial Scenario II--Regulatory Alternative III

Under financial scenario I, Regulatory Alternative I is projected to result in failures only of firms in below-average financial condition at baseline (see Figure 7-9). Regulatory Alternatives II and III, however, are projected to result in failures of firms in both average and below-average baseline financial condition, though there are no failures with a size cutoff of $50,000 or higher (see Figures 7-10 and 7-11).

Under financial scenario II with no systematic relationship between firm size and financial condition, a share of projected closures are among firms in average and above-average financial condition, but only with no size cutoff or a $25,000 size cutoff. With any size cutoff of $50,000 or higher, all projected closures are of firms in below-average financial condition (see Figures 7-12 through 7-14).

7.5 EFFECTS ON SMALL BUSINESSES

The Regulatory Flexibility Act requires that special consideration be given to the impacts of all proposed regulations affecting small businesses. Obviously, small business effects within the industrial sector are not an issue because production cost savings are predicted for this sector. Therefore, the focus of the analysis of small business effects will be limited to the coin-operated and commercial sectors.

The Small Business Administration (SBA) sets the standards for classifying a business as small. If 20 percent of the small affected firms in a regulated industry will incur a significant adverse economic impact then a Regulatory Flexibility Analysis must be prepared or size cutoffs that mitigate impacts on small facilities must be implemented. Criteria for determining what is a "significantly adverse economic impact" on small business entities are as follows (EPA, 1982):

- Annual compliance costs increase total costs of production for small entities by more than 5 percent.
- Compliance costs as a percent of sales for small entities are at least 10 percent higher than compliance costs as a percent of sales for large entities.

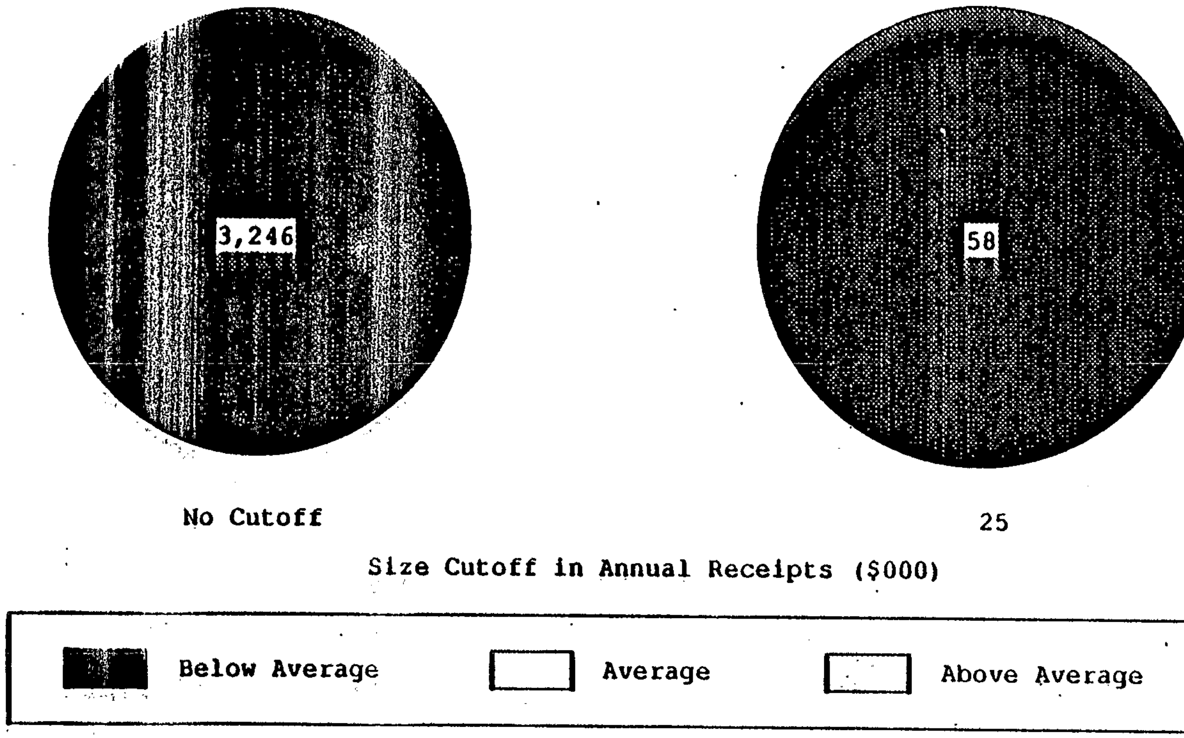


Figure 7-9. Baseline Financial Condition of Projected Business Failures, Financial Scenario I--Regulatory Alternative I

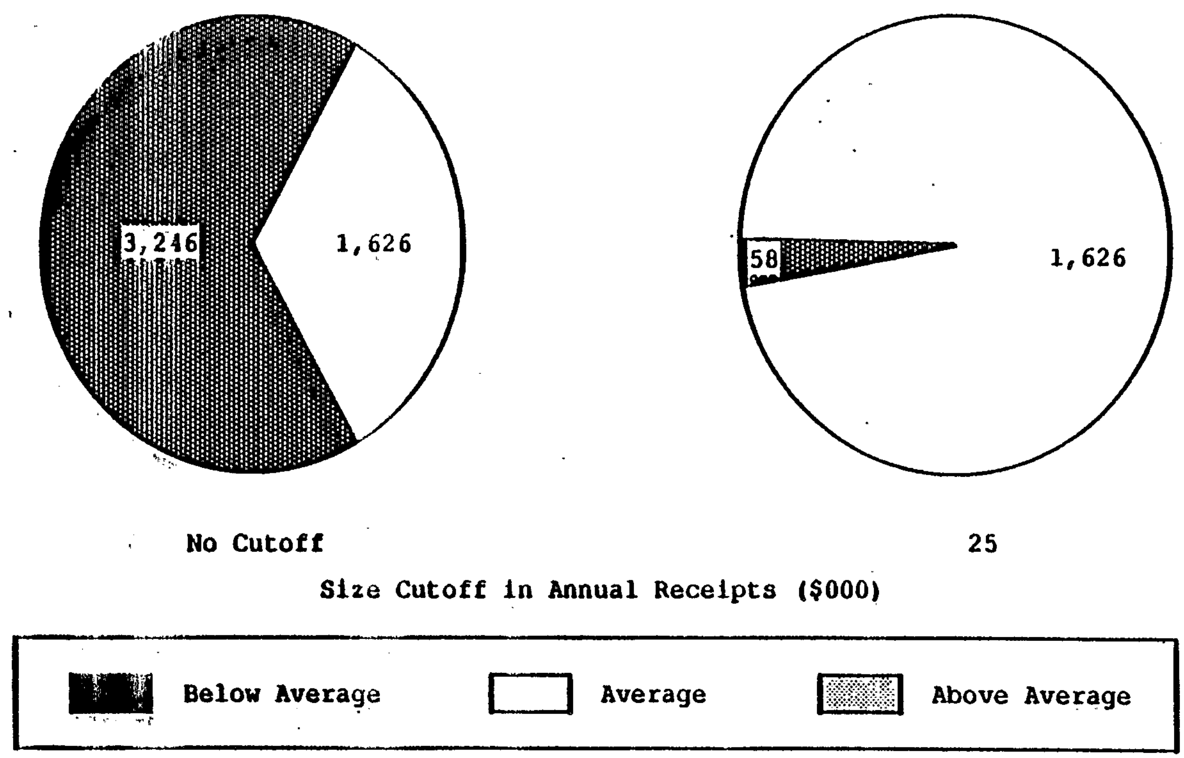


Figure 7-10. Baseline Financial Condition of Projected Business Failures, Financial Scenario I--Regulatory Alternative II

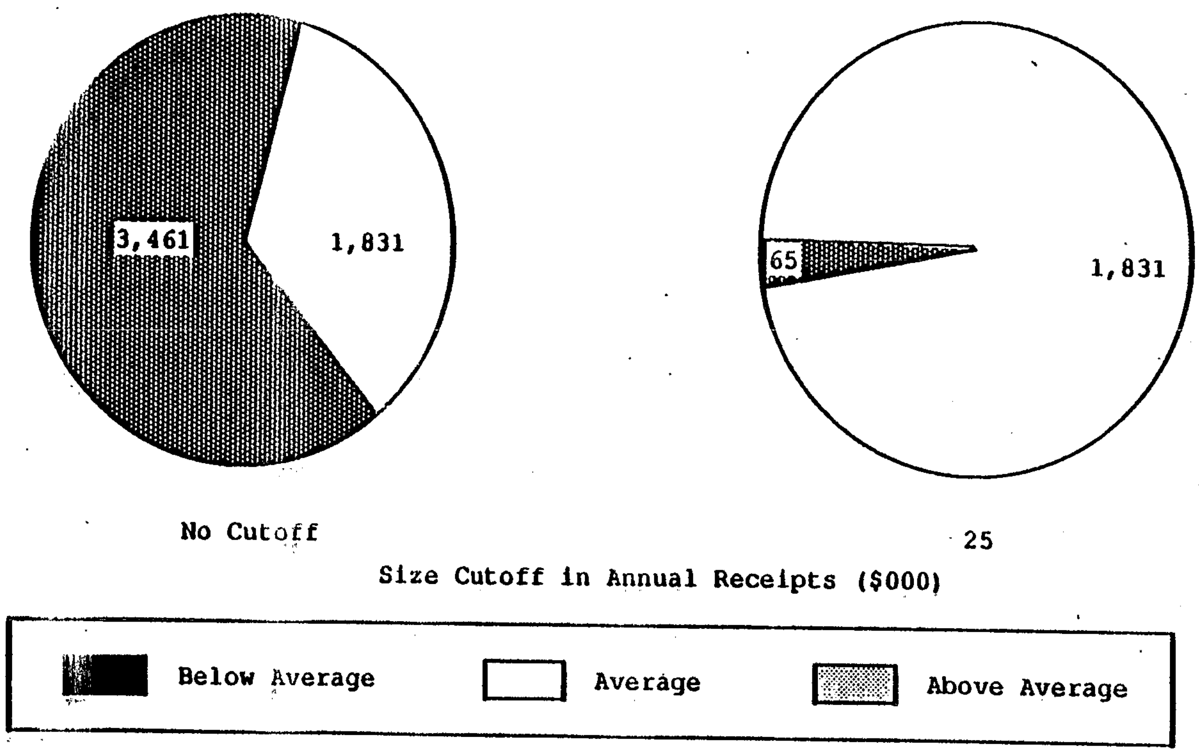


Figure 7-11. Baseline Financial Condition of Projected Business Failures, Financial Scenario I--Regulatory Alternative III

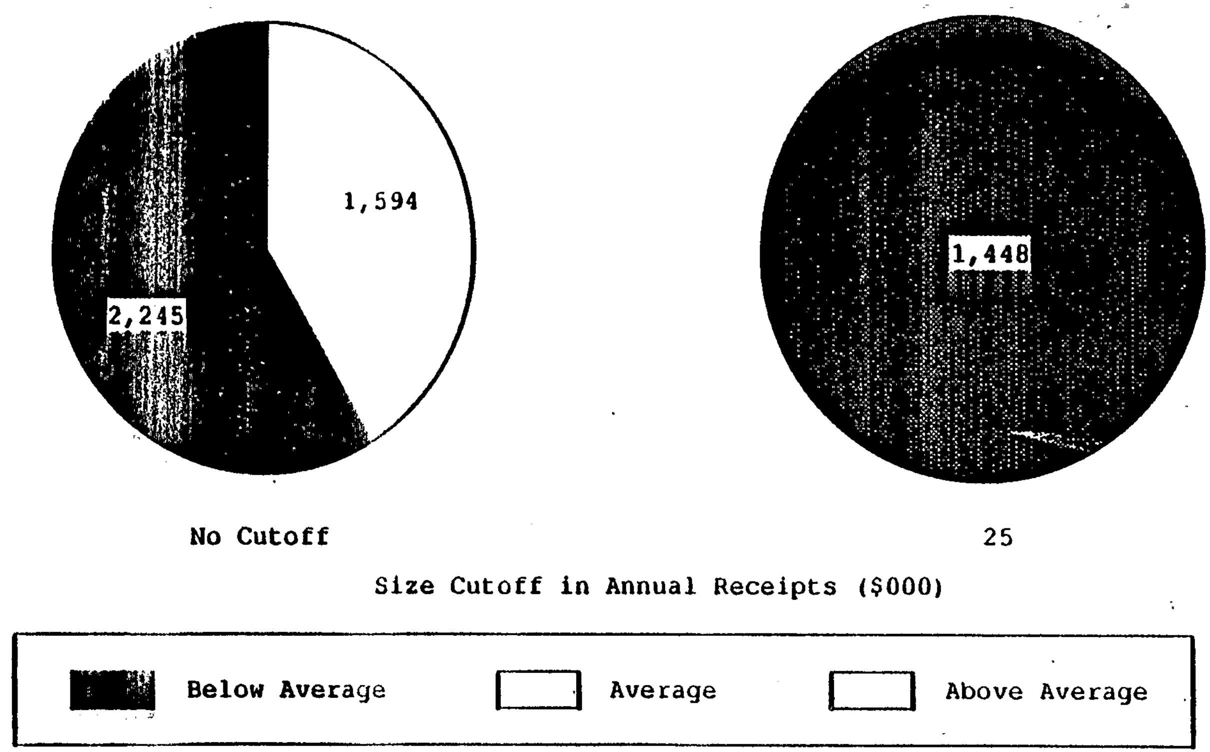


Figure 7-12. Baseline Financial Condition of Projected Business Failures, Financial Scenario II--Regulatory Alternative I

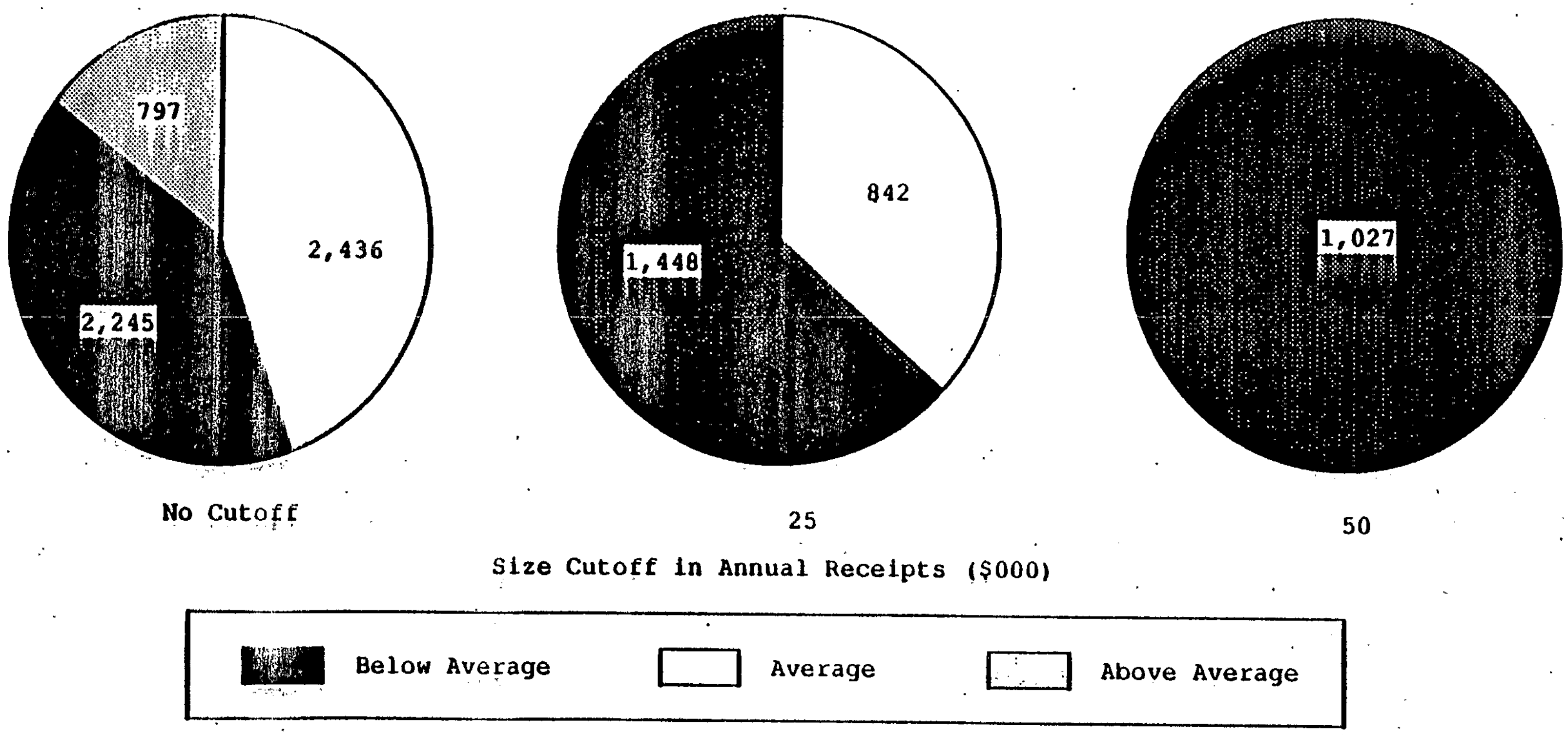


Figure 7-13. Baseline Financial Condition of Projected Business Failures, Financial Scenario II--Regulatory Alternative II

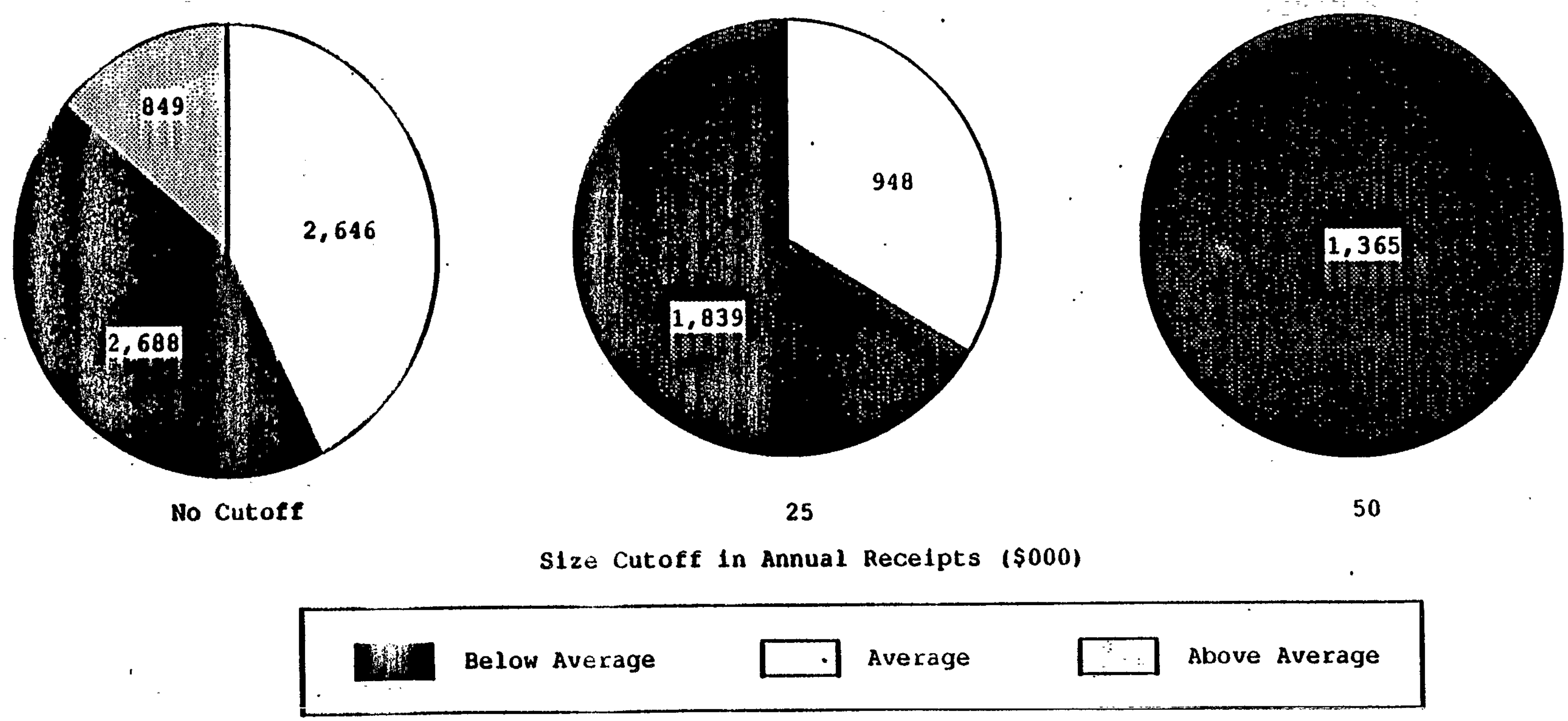


Figure 7-14. Baseline Financial Condition of Projected Business Failures, Financial Scenario II--Regulatory Alternative III

- Capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow plus external financing capabilities.

- The requirements of the regulation are likely to result in closures of small entities.

Firms in the dry cleaning industry are classified as small or large based on annual sales receipts (Code of Federal Regulations, 1991). For the coin-operated sector small businesses are defined as firms earning less than $3.5 million in annual receipts. Likewise commercial firms are classified as small if they earn less than $2.5 million per year. By these definitions, over 99 percent of coin-operated and commercial dry cleaning firms are small (U.S. Dept. of Commerce, 1990b).

There are an estimated 27,332 commercial dry cleaning firms operating in the U.S. Table 7-38 projects the number of commercial firms likely to experience financial failure under financial scenario I and the share of all commercial firms that this number represents. Under Alternative I, about 11.9 percent of commercial firms are likely to experience financial failure with no size cutoff to mitigate the impacts of the regulation. Under Regulatory Alternative II approximately 17.8 percent of firms will experience financial failure, and under Alternative III the share of firms that experience financial failure is about 19.4 percent. If a size cutoff equivalent to $25,000 in annual receipts is included in the regulation, the share of firms in the commercial sector that experience financial failure decreases to 0.2, 6.2, and 6.9 percent under Regulatory Alternatives I, II, and III, respectively. If any size cutoff is included as part of the regulation, the share of financial failures falls well below the 20 percent criterion under all three alternatives.

Table 7-39 projects the number of commercial firms likely to experience financial failure under financial scenario II and the share of all commercial firms that this number represents. Under Alternative I, about 14 percent of commercial firms are likely to experience financial failure with no size cutoff to mitigate the impacts of the regulation. Under Regulatory Alternative II approximately 20 percent of firms will experience financial failure, and under Alternative III the share of firms that experience financial failure is about 23 percent. If a size cutoff equivalent to $25,000 in annual receipts is included in the regulation, the share of firms in the commercial sector that experience financial failure decreases to 5, 8, and 10 percent under Regulatory Alternatives I, II, and III, respectively.

Unquestionably, self-service coin-operated facilities would incur the largest percentage increase in production costs as a result of the NESHAP. The majority of these facilities are relatively small entities, especially in comparison to commercial and industrial plants. With no cutoff to mitigate impacts, more than 20 percent of the facilities with dry cleaning capacity in this sector would experience adverse economic impacts. However, if any size cutoff above $25,000 is included in the regulation, virtually all coin-operated laundries will be exempt.

SECTION 8

CONCLUSION

This Economic Impact Analysis (EIA) examines the economic and financial impacts associated with three regulatory alternatives considered for proposal in the dry cleaning industry. In addition, five size cutoff levels based on solvent consumption corresponding to target levels of annual receipts are analyzed.

Of particular concern to EPA is the large number of small entities potentially affected by the regulation. The commercial and coin-operated sectors of the dry cleaning industry are comprised of thousands of small facilities. According to Census data, approximately two-thirds of commercial facilities and over 85 percent of coin-operated facilities earn less than $100 thousand in annual receipts (U.S. Department of Commerce 1990a; U.S. Department of Commerce 1990b). The industrial sector has much larger facilities with over 90 percent earning over $100 thousand in annual receipts. The alternatives do not apply to all facilities in these three sectors. Only those facilities that use PCE[1] and do not have the required control equipment are affected under the alternatives analyzed. Over 12,000 potentially affected facilities are in the commercial sector, and approximately 1,600 potentially affected facilities are in the coin-operated sector. The industrial sector includes only about 65 potentially affected facilities.

An integrated approach that considers both the economic and financial impacts of the alternatives is used to address the concerns regarding small business impacts. Key elements of the economic analysis are listed below:

- Analyzed impacts using a model plant approach based on 15 model plants that characterize machine technology, machine capacity, and operating practices of typical dry cleaning machines. Impacts are measured at multiple capacity utilization levels for each model facility.

[1]The regulatory alternatives apply to facilities that use PCE or 1,1,1-TCA. However, all facilities that use 1,1,1-TCA are in compliance with the candidate regulatory alternatives in the baseline. Therefore, impacts are computed only for facilities that use PCE.

- Analyzed impacts using an urban/rural model market approach. Model markets differentiate the market for dry cleaning services by number of facilities in the market, the share of affected and unaffected facilities in the market, the baseline price of dry cleaning services, and the projected behavioral response to regulation.

- Estimated supply and demand elasticities using simultaneous equation modelling techniques and recent time-series data.

- Estimated the weighted average cost of capital (WACC) for firms in below-average, average, and above-average financial condition. Computed annualized compliance costs using engineering data and the WACC estimated for firms.

- Estimated short-run price and output adjustments and corresponding consumer and producer welfare impacts using applied welfare economics.

- Projected net plant closures based on the assumption that the entire reduction in output is accounted for by the smallest size affected plants leaving the industry.

- Estimated one-time worker displacements and displacement costs

The financial analysis of affected dry cleaning firms is based on the costs computed for the economic analysis. Key elements of the financial analysis are listed below:

- Characterized the baseline distribution of commercial dry cleaning firms by financial condition and firm size under two financial scenarios. Financial scenario I assumes that since capacity utilization is significantly lower at smaller firms, all firms in below-average baseline financial condition have annual receipts below $50,000, that all firms in average condition have annual receipts between $25,000 and $250,000, and that all firms in above-average condition have receipts of at least $100,000. Financial scenario II assumes that 25 percent of all firms of all sizes are in below-average condition, 50 percent are in average financial condition, and 25 percent are in above-average condition.

- Constructed _pro forma_ baseline financial statements and financial ratios of commercial dry cleaning firms of different sizes in below-average, average, and above-average financial condition to allow assessment of the financial impacts of regulatory alternatives with alternative size cutoffs.

- Evaluated the availability of funds to firms of different baseline financial condition and different output levels.

- Evaluated profitability impacts on firms by baseline financial status and baseline output level.

- Projected changes in ownership due to profitability impacts and capital availability constraints.

The economic and financial impacts are computed for three regulatory alternatives and five size cutoff levels. In all, fifteen regulatory scenarios are considered. The analysis shows that including a size cutoff significantly decreases economic and financial impacts. To show the mitigating influence of a size cutoff, two regulatory scenarios--Alterntive I with no size cutoff and Alternative II with a cutoff corresponding to $100,000 in annual receipts--are highlighted in the balance of this section.

The total annualized cost is estimated at $42.9 million under Regulatory Alternative II with no cutoff. These regulatory costs result in short-run price increases and output decreases representing less than one percent deviation from baseline values. Producers and consumers are projected to incur approximately $18 million and $25 million in welfare losses, respectively. The minimal price and quantity adjustments estimated indicate that impacts on consumers are relatively small. Impacts on producers, however, are not distributed across all producers equally. The impacts that an individual dry cleaning firm may incur depend on a combination of the market conditions, the baseline financial condition of the firm, and the size of the firm.

Alternative II with no cutoff would result in an estimated 1600 net plant closures assuming that the reduction in output is entirely accounted for by closure of the smallest size affected facility. In addition, an estimated 920 employees in the commercial sector alone would lose their jobs resulting in an estimated $26.5 million in one-time worker displacement costs.

The results of the financial analysis indicate that small businesses are likely to incur significant adverse impacts unless a size cutoff is included in the regulation. For example, under Regulatory Alternative II and financial scenario I, approximately 4,872 changes in ownership are projected with no size cutoff. None of these projected changes are for firms in above-average financial condition, and two-thirds are for firms below-average condition. Under financial scenario

II, about 14 percent of the approximately 5,500 changes in ownership represent businesses in above-average baseline financial condition, another 44 percent are in average financial condition, and the remaining 42 percent are in below-average financial condition.

The Regulatory Flexibility Act requires that special consideration be given to the impacts of all proposed regulations affecting small businesses. To comply with the guidelines set forth in the Act and to help mitigate the impacts of the alternative selected for proposal, five cutoff levels based on solvent consumption that correspond to target levels of annual receipts are considered. The inclusion of a cutoff level corresponding to $100,000 in annual receipts would result in the following economic and financial impacts under Regulatory Alternative II:

• Annualized costs	$11.5 million
• Producer welfare losses	$4.8 million
• Consumer welfare losses	$6.7 million
• Net plant closures	28
• Number worker displacements	354
• Worker displacement costs	$10.2 million
• Projected changes in ownership	0 - 669

Impacts under Alternative II with no cutoff are significantly higher than impacts with a cutoff corresponding to $100,000 in annual receipts. Annualized costs, producer welfare losses, and consumer welfare losses are reduced by about 73 percent compared to the impacts with no cutoff. Projected net plant closures are reduced by over 98 percent. It should be noted that the 28 net plant closures projected with the cutoff represent much larger plants on average (over $100,000 in annual receipts per plant) than the 1600 closures projected with no cutoff (less than $25,000 in annual receipts per plant). Worker displacements and corresponding displacement costs would be reduced by over 60 percent. Perhaps the most significant reduction in impacts is seen in the projected changes in ownership. Under the financial scenario I assumption that all firms in below-average financial condition at baseline have annual receipts below $50,000, there are no projected changes in ownership. Under the financial scenario II assumption, approximately 4,800 fewer changes are projected with a cutoff, and all of those are in below-average condition at baseline.

EPA must propose a regulation that adequately reduces the level of HAP emissions while considering the impacts on small businesses. This EIA measures the small business impacts under each of the regulatory alternatives and helps to provide quantitative support for selecting the regulatory scenario that meets both criteria.

SECTION 9

REFERENCES

Abowd, John M. and Orley Ashenfelter. 1981. "Anticipated Unemployment, Temporary Layoffs, and Compensating Wage Differentials." In Studies in Labor Markets, pp 141-170. Sherwin Rosen, ed. Chicago, IL: University of Chicago Press.

Allen, R.G.D. 1962. Mathematical Analysis for Economists. London: MacMillan & Co.

Altman, Edward I. 1983. Corporate Financial Distress. pp 4-7. New York: John Wiley and Sons.

American Business Information (ABI). 1991. Data Base of Dry Cleaning Facilities. Prepared for Research Triangle Institute.

Anderson, D. W., and Ram V. Chandran. 1987. "Market Estimates of Worker Dislocation Costs." Economics Letters 24:381-384.

Anderson, Donald W., Mims, Howard H., and Ross, A. Scott. 1987. Industry Supply, Cost and Availability of Capital, and Closure Analysis. Prepared by Research Triangle Institute for U.S. Environmental Protection Agency. September 30.

Bass, Archie. 1991. Commercial Loan Officer, Central Carolina Bank, March 22, 1991. Personal communication with Donald W. Anderson, Research Triangle Institute.

Becker, Gary S. 1965. "A Theory of the Allocation of Time." Reprinted from the Economic Journal 75:493-517. September.

Behrens, Robert H. 1985. Commercial Loan Officer's Handbook. Boston: Banker's Publishing Company.

Betchkal, Mark. 1987a. Institute of Industrial Launderers, with Lisa McNeilly. February 19, 1987. Personal communication with Research Triangle Institute.

Betchkal, Mark. 1987b. Institute of Industrial Launderers, with Lisa McNeilly. March 2, 1987. Personal communication with Research Triangle Institute.

Blinder, Alan S. 1988. "The Challenge of High Unemployment." Richard T. Ely Lecture printed in the American Economic Review 78(2):1-15.

Bowlin, Oswald D., Martin, John D., and Scott, David F. 1990. Guide to Financial Analysis. pp 229-233. New York: McGraw-Hill.

Busler, C. 1980. "Characteristics of Dry Cleaning Solvents." International Fabricare Institute Technical Bulletin No. T-536.

Chemical Marketing Reporter. 1986. "Chemical Profile: Perchloroethylene." 229(5):50, February 3.

Clark, Lyman H. 1989. Small Business Financial Data Bases. Prepared for the Office of Policy, Planning, and Evaluation, U.S. Environmental Protection Agency.

Code of Federal Regulations. 1991. "Business Credit and Assistance." Revised as of January 1, 1991. National Archives and Records Administration.

Coor, Kenneth R., Division President, and Grady Kenneth W., Production Manager, Textilease Corporation. February 19, 1991. Personal communication with Brenda L. Jellicorse, Research Triangle Institute.

Deacon, Robert T. and Jon Sonstelie. 1985. "Rationing by Waiting and the Value of Time: Results from a Natural Experiment." Journal of Political Economy 93(4):627-647.

Duns Analytical Services. 1990. Industry Norms and Key Business Ratios. Dun and Bradstreet Business Credit Services. 1989-1990.

Economic Report of the President. 1990. Washington, DC: United States Government Printing Office. February.

Faig, Kenneth. 1990. International Fabricare Institute. March 14, 1990. Personal communication with Brenda L. Jellicorse, Research Triangle Institute.

Faig, Kenneth. 1991. International Fabricare Institute, February 25, 1991. Personal communication with Brenda L. Jellicorse., Research Triangle Institute.

Federal Register. 1989. "Occupational Safety and Health Administration, 29 CFR Part 1910, Air Contaminants." 54(12):2812. January 19.

Fischer, E. 1987. Editor of American Drycleaner. February 6, 1987. Personal communication with Lisa McNeilly, Research Triangle Institute.

Fisher, William. 1987. International Fabricare Institute, February 13, 1987. Personal communication with Lisa McNeilly, Research Triangle Institute.

Fisher, William. 1990a. . International Fabricare Institute. March 6, 1990. Personal communication with Brenda L. Jellicorse, Research Triangle Institute.

Fisher, William. 1990b. International Fabricare Institute, October 10, 1990. Teleconference with EPA staff, Radian Corporation staff, and Brenda L. Jellicorse, Research Triangle Institute.

Flaim, Paul O. 1984. "Unemployment in 1982: The Cost to Workers and Their Families." Monthly Labor Review Feb.:30-37

Gordon, Robert J. 1978. Macroeconomics. pp 271-275. Boston: Little Brown and Company.

Gronau, Reuben. 1977. "Leisure, Home Production, and Work--the Theory of the Allocation of Time Revisited." Journal of Political Economy 85(6):1099-1123.

Hamermesh, Daniel S. 1989. "What Do We Know About Worker Displacement in the U.S.?" Industrial Relations 28(1):51-59.

Hatsopoulos, George N. 1991. "Cost of Capital: Reflections of a CEO." Business Economics. 26(2):7-13.

Houthakker, H. S., and Taylor, L. D. 1970. Consumer Demand in the United States: Analysis and Projections. Cambridge, MA: Harvard Univ. Press.

ICF, Inc. 1986. Costs of Substitutes for Chlorinated Solvents in Dry Cleaning. Draft Report to U.S. Environmental Protection Agency. April.

International Fabricare Institute. 1989. "Results of IFI Survey of 1988 Operating Costs." IFI Fabricare News. September.

Jones, C.P. Dr. 1991. Professor of Economics and Business, North Carolina State University, March 22, 1991. Personal communication with Donald W. Anderson, Research Triangle Institute.

Kooreman, Peter and Arie Kapteyn. 1987. "A Disaggregated Analysis of the Allocation of Time within the Household." Journal of Political Economy 95(2):223-249.

Martin, Stephen. 1982. "Industry Demand Characteristics and the Structure-Performance Relationship." Journal of Economics and Business 34:59-65.

Mason, Charles, and Clifford Butler. 1987. "New Basket of Goods and Services being Priced in Revised CPI." Monthly Labor Review. January.

Maxwell, Nan L. 1989. "Labor Market Effects from Involuntary Job Losses in Layoffs, Plant Closings: The Role of Human Capital in Facilitating Reemployment and Reduced Wage Losses." American Journal of Economics and Sociology 48(2):129-141.

Moore, Michael J. and W. Kip Viscusi. 1990. Compensation Mechanics for Job Risks. Princeton, NJ: Princeton University Press.

Radian Corporation. 1990a. "National Cost Impacts of Regulatory Alternatives for the Hazardous Air Pollutant Dry Cleaning NESHAP." Memorandum from Carolyn Norris and Kim Kepford to U.S. Environmental Protection Agency, Chemical and Petroleum Branch. January 25.

Radian Corporation. 1990b. "Revised Estimates of National Hazardous Air Pollutant Consumption by the Dry Cleaning Industry." Memorandum from Carolyn Norris and Kim Kepford to U.S. Environmental Protection Agency, Chemical and Petroleum Branch. December 14.

Radian Corporation. 1990c. "Revised Model Machine Selection for the Dry Cleaning NESHAP." Memorandum from Carolyn Norris and Kim Kepford to U.S. Environmental Protection Agency, Chemical and Petroleum Branch. December 14.

Radian Corporation. 1990d. "Updated Control Costs and Cost-Effectiveness Estimates for Hazardous Air Pollutant (HAP) Dry Cleaners." Memorandum from Carolyn Norris and Kim Kepford to U.S. Environmental Protection Agency, Chemical and Petroleum Branch. December 14.

Radian Corporation. 1991a. "Documentation of Growth Rates for the Dry Cleaning Industry." Memorandum from Carolyn Norris and Kim Kepford to U.S. Environmental Protection Agency, Chemical and Petroleum Branch. March 11.

Radian Corporation. 1991b. "Existing State Exemption Levels." Memorandum from Kim Kepford to Brenda L. Jellicorse, Research Triangle Institute. January 7.

Radian Corporation. 1991c. "Modelling the Low Income Sector of the HAP Dry Cleaning Industry." Memorandum from Carolyn Norris and Kim Kepford to U.S. Environmental Protection Agency, Chemical and Petroleum Branch. March 1.

Safety-Kleen. 1986. <u>Analysis of Dry Cleaning Industry</u>.

Sherer, F.M. 1980. <u>Industrial Market Structure and Economic Performance</u>. 2nd ed., Chicago: Rand McNally College Publishing Company.

Sluizer, Bud. 1990. Institute of Industrial Launderers, March 12, 1990. Personal communication with Brenda L. Jellicorse, Research Triangle Institute.

Steinhoff, Dan and Burgess, John F. 1989. <u>Small Business Management Fundamentals</u>. 5th ed.. New York: McGraw-Hill.

Tax Foundation 1991. Facsimile from Gregg Leong, The Tax Foundation, Washington, DC.

Topel, Robert H. 1984. "Equilibrium Earnings, Turnover, and Unemployment: New Evidence." <u>Journal of Labor Economics</u> 2(4):500-522.

Torp, Richard. 1990. Coin Laundry Association, February 27, 1990. Personal communication with Brenda L. Jellicorse, Research Triangle Institute.

Torp, Richard. 1991. International Fabricare Institute. February 8, 1991. Personal communication with Kristy Mathews, Research Triangle Institute.

U.S. Department of Commerce, Bureau of Census. 1985. <u>1982 Census of Service Industries, Miscellaneous Subjects</u>. Washington, DC: U.S. Government Printing Office. December.

U.S. Department of Commerce, Bureau of Census. 1988. <u>County and City Data Book 1988</u>. Washington, DC: U.S. Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1989a. <u>Statistical Abstract of the United States</u>. Washington, D.C.: U.S. Government Printing Office.

U.S. Department of Commerce, Bureau of Census. 1990a. <u>1987 Census of Service Industries, Non Employer Statistics Series</u>. Washington, DC: U.S. Government Printing Office. March.

U.S. Department of Commerce, Bureau of Census. 1990b. <u>1987 Census of Service Industries, Subject Series</u>. Washington: U.S. Government Printing Office. April.

U.S. Department of Commerce, Bureau of the Census. 1990c. 1987 Census of Service Industries, Geographic Area Series. Washington, D.C.: Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1990d. Statistical Abstract of the United States. Washington, DC: U.S. Government Printing Office.

U.S. Department of Commerce, Bureau of the Census. 1991. Current Population Surveys Branch, April 15, 1991. Personal communication with Kristy Mathews, Research Triangle Institute.

U.S. Department of Commerce, Bureau of Economic Analysis. 1989b. Survey of Current Business. Washington, DC: U.S. Government Printing Office. March.

U.S.Department of Labor, Bureau of Labor Statistics, 1991a. 1980-1989 Consumer Expenditure Survey. Washington, DC: United States Government Printing Office.

U.S. Department of Labor, Bureau of Labor Statistics. 1991b. Employment and Earnings. Washington, DC: U.S. Government Printing Office. April.

U.S. Environmental Protection Agency. 1982. "EPA Implementation of the Regulatory Flexibility Act." Memorandum from Anne M. Gorsuch to EPA Administrators and Office Directors. February 9.

Van Horne, James C. 1980. Financial Management and Policy. 5th ed. Englewood Cliffs: Prentiss Hall.

TABLE A-1. BASELINE FINANCIAL STATEMENTS OF DRY CLEANING FIRMS IN BELOW-AVERAGE FINANCIAL CONDITION

Company Sales Range	< $25K	$25-50K	$50-75K	$75-100K	> $100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods sold	8,288	18,948	31,320	43,848	171,746
gross profit	9,448	21,597	35,701	49,981	195,764
other expenses and taxes	9,270	21,192	35,030	49,042	192,090
net profit	177	405	670	938	3,675
Balance Sheet					
cash	315	720	1,190	1,666	6,526
accounts receivable	1,225	2,799	4,627	6,478	25,373
cash plus accounts receivable	1,539	3,519	5,817	8,144	31,900
other current assets	924	2,112	3,490	4,887	19,140
total current assets	2,463	5,630	9,308	13,031	51,039
fixed assets	7,698	17,597	29,087	40,722	159,500
other non-current assets	2,255	5,154	8,520	11,928	46,718
total assets	12,415	28,382	46,915	65,680	257,257
accounts payable	665	1,520	2,513	3,518	13,779
loans payable	58	132	218	306	1,198
notes payable	795	1,817	3,004	4,206	16,474
other current liabilities	1,561	3,569	5,899	8,259	32,349
total current liabilities	3,079	7,039	11,635	16,289	63,800
non-current liabilities	4,370	9,990	16,514	23,119	90,554
total liabilities	7,449	17,029	28,149	39,408	154,354
net worth	4,966	11,353	18,766	26,272	102,903
capital	9,336	21,343	35,280	49,392	193,457
Total Liabilities and Net Worth	12,415	28,382	46,915	65,680	257,257

TABLE A-2. BASELINE FINANCIAL STATEMENTS OF DRY CLEANING FIRMS IN AVERAGE FINANCIAL CONDITION

Company Sales Range	< $25K	$25-50K	$50-75K	$75-100K	> $100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	[illegible]7,510
cost of goods sold	7,786	17,799	29,422	41,191	61,337
gross profit	9,950	22,746	37,599	52,638	206,173
other expenses and taxes	8,709	19,908	32,907	46,070	180,448
net profit	1,241	2,838	4,691	6,568	25,725
Balance Sheet					
cash	1,548	3,540	5,851	8,191	32,083
accounts receivable	650	1,486	2,457	3,439	13,471
cash plus accounts receivable	2,198	5,026	8,308	11,630	45,554
other current assets	958	2,190	3,620	5,069	19,853
total current assets	3,157	7,216	11,928	16,699	65,407
fixed assets	3,191	7,295	12,057	16,880	66,117
other non-current assets	2,207	5,045	8,340	11,676	45,732
total assets	8,555	19,556	32,325	45,255	177,257
accounts payable	394	900	1,487	2,082	8,154
loans payable	34	78	129	181	709
notes payable	471	1,076	1,778	2,489	9,749
other current liabilities	924	2,112	3,491	4,888	19,144
total current liabilities	1,822	4,165	6,885	9,639	37,755
non-current liabilities	2,105	4,811	7,952	11,133	43,606
total liabilities	3,927	8,976	14,837	20,772	81,361
net worth	4,628	10,579	17,488	24,483	95,895
capital	6,732	15,391	25,440	35,616	139,501
Total Liabilities and Net Worth	8,555	19,556	32,325	45,255	177,257

TABLE A-3. BASELINE FINANCIAL STATEMENTS OF DRY CLEANING FIRMS IN ABOVE-AVERAGE FINANCIAL CONDITION

Company Sales Range	< $25K	$25-50K	$50-75K	$75-100K	> $100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods sold	7,284	16,651	27,524	38,533	150,928
gross profit	10,452	23,894	39,497	55,296	216,582
other expenses and taxes	8,147	18,624	30,784	43,098	168,806
net profit	2,305	5,270	8,713	12,198	47,776
Balance Sheet					
cash	1,379	3,152	5,211	7,295	28,574
accounts receivable	267	611	1,010	1,414	5,538
cash plus accounts receivable	1,646	3,763	6,221	8,709	34,112
other current assets	753	1,720	2,844	3,981	15,594
total current assets	2,399	5,484	9,065	12,691	49,706
fixed assets	2,352	5,377	8,887	12,442	48,732
other non-current assets	2,344	5,358	8,857	12,399	48,566
total assets	7,095	16,218	26,808	37,532	147,004
accounts payable	102	232	384	537	2,105
loans payable	9	20	33	47	183
notes payable	121	278	459	643	2,517
other current liabilities	238	545	901	1,262	4,942
total current liabilities	470	1,075	1,777	2,488	9,746
non-current liabilities	594	1,358	2,244	3,141	12,305
total liabilities	1,064	2,433	4,021	5,630	22,051
net worth	6,030	13,785	22,787	31,902	124,953
capital	6,624	15,143	25,031	35,043	137,258
Total Liabilities and Net Worth	7,095	16,218	26,808	37,532	147,004

TABLE A-4. FINANCIAL STATEMENTS OF FIRMS IN BELOW-AVERAGE FINANCIAL CONDITION: REGULATORY ALTERNATIVE I

Company Sales Range	$0-25K	$25-50K	$50-75K	$75-100K	$ >100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods	8,288	18,948	31,320	41,191	43,848
gross profit	9,448	21,597	35,701	49,981	195,764
other expenses and taxes	9,608	21,464	35,216	49,179	191,990
net profit	-161	133	485	801	3,774
Balance Sheet					
cash	-7,200	-6,582	-5,614	-5,667	-10,011
accounts receivable	1,225	2,799	4,627	6,478	25,373
cash plus accounts receivable	-5,975	-3,783	-987	811	15,362
other current assets	924	2,112	3,490	4,887	19,140
total current assets	-5,052	-1,671	2,504	5,697	34,502
fixed assets	15,212	24,899	35,891	48,055	176,037
other non-current assets	2,255	5,154	8,520	11,928	46,718
total assets	12,415	28,382	46,915	65,680	257,257
accounts payable	665	1,520	2,513	3,518	13,779
loans payable	58	132	218	306	1,198
notes payable	795	1,817	3,004	4,206	16,474
other current liabilities	1,561	3,569	5,899	8,259	32,349
total current liabilities	3,079	7,039	11,635	16,289	63,800
non-current liabilities	4,370	9,990	16,514	23,119	90,554
total liabilities	7,449	17,029	28,149	39,408	154,354
net worth	4,966	11,353	18,766	26,272	102,903
capital	9,336	21,343	35,280	49,392	193,457
Total Liabilities and Net Worth	12,415	28,382	46,915	65,680	257,257

TABLE A-5. FINANCIAL STATEMENTS OF FIRMS IN AVERAGE FINANCIAL CONDITION: REGULATORY ALTERNATIVE I

Company Sales Range	$0-25K	$25-50K	$50-75K	$75-100K	$ >100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods	7,786	17,799	29,422	41,191	161,337
gross profit	9,950	22,746	37,599	52,638	206,173
other expenses and taxes	10,667	21,754	34,560	47,789	183,915
net profit	-717	991	3,038	4,849	22,258
Balance Sheet					
cash	1,548	3,540	5,851	8,191	32,083
accounts receivable	650	1,486	2,457	3,439	13,471
cash plus accounts receivable	2,198	5,026	8,308	11,630	45,554
other current assets	958	2,190	3,620	5,069	19,853
total current assets	3,157	7,216	11,928	16,699	65,407
fixed assets	10,706	14,596	18,861	24,214	82,655
other non-current assets	2,207	5,045	8,340	11,676	45,732
total assets	16,069	26,858	39,129	52,589	193,794
accounts payable	394	900	1,487	2,082	8,154
loans payable	34	78	129	181	709
notes payable	2,091	2,650	3,245	4,071	13,315
other current liabilities	924	2,112	3,491	4,888	19,144
total current liabilities	3,443	5,740	8,353	11,221	41,322
non-current liabilities	8,863	11,378	14,071	17,728	58,479
total liabilities	12,306	17,118	22,424	28,949	99,801
net worth	3,764	9,740	16,705	23,640	93,993
capital	12,627	21,118	30,777	41,368	152,472
Total Liabilities and Net Worth	16,069	26,858	39,129	52,589	193,794

TABLE A-6. FINANCIAL STATEMENTS OF FIRMS IN ABOVE-AVERAGE FINANCIAL CONDITION: REGULATORY ALTERNATIVE I

Company Sales Range	$0-25K	$25-50K	$50-75K	$75-100K	$ >100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods	7,284	16,651	27,524	38,533	150,928
gross profit	10,452	23,894	39,497	55,296	216,582
other expenses and taxes	10,079	20,445	32,414	44,791	172,216
net profit	373	3,449	7,083	10,504	44,366
Balance Sheet					
cash	1,379	3,152	5,211	7,295	28,574
accounts receivable	267	611	1,010	1,414	5,538
cash plus accounts receivable	1,646	3,763	6,221	8,709	34,112
other current assets	753	1,720	2,844	3,981	15,594
total current assets	2,399	5,484	9,065	12,691	49,706
fixed assets	9,867	12,678	15,691	19,775	65,270
other non-current assets	2,344	5,358	8,857	12,399	48,566
total assets	14,609	23,520	33,612	44,865	163,542
accounts payable	102	232	384	537	2,105
loans payable	9	20	33	47	183
notes payable	1,716	1,827	1,903	2,199	6,026
other current liabilities	238	545	901	1,262	4,942
total current liabilities	2,065	2,625	3,221	4,045	13,256
non-current liabilities	7,341	7,913	8,352	9,725	27,152
total liabilities	9,406	10,538	11,574	13,770	40,408
net worth	5,204	12,982	22,039	31,095	123,134
capital	12,544	20,895	30,391	40,821	150,286
Total Liabilities and Net Worth	14,609	23,520	33,612	44,865	163,542

TABLE A-7. FINANCIAL STATEMENTS OF FIRMS IN BELOW-AVERAGE FINANCIAL CONDITION: REGULATORY ALTERNATIVE II

Company Sales Range	$0-25K	$25-50K	$50-75K	$75-100K	$ >100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods	8,288	18,948	31,320	43,848	171,746
gross profit	9,448	21,597	35,701	49,981	195,764
other expenses and taxes	11,059	22,663	35,828	50,140	193,894
net profit	-1,611	-1,065	-127	-160	1,871
Balance Sheet					
cash	-6,367	-5,893	-5,261	-5,114	-8,696
accounts receivable	1,225	2,799	4,627	6,478	25,373
cash plus accounts receivable	-5,142	-3,094	-634	1,364	16,678
other current assets	924	2,112	3,490	4,887	19,140
total current assets	-4,219	-982	2,856	6,251	35,818
fixed assets	14,379	24,209	35,539	47,502	174,722
other non-current assets	2,255	5,154	8,520	11,928	46,718
total assets	12,415	28,382	46,915	65,680	257,257
accounts payable	665	1,520	2,513	3,518	13,779
loans payable	58	132	218	306	1,198
notes payable	795	1,817	3,004	4,206	16,474
other current liabilities	1,561	3,569	5,899	8,259	32,349
total current liabilities	3,079	7,039	11,635	16,289	63,800
non-current liabilities	4,370	9,990	16,514	23,119	90,554
total liabilities	7,449	17,029	28,149	39,408	154,354
net worth	4,966	11,353	18,766	26,272	102,903
capital	9,336	21,343	35,280	49,392	193,457
Total Liabilities and Net Worth	12,415	28,382	46,915	65,680	257,257

TABLE A-8. FINANCIAL STATEMENTS OF FIRMS IN AVERAGE FINANCIAL CONDITION: REGULATORY ALTERNATIVE II

Company Sales Range	$0-25K	$25-50K	$50-75K	$75-100K	$ >100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods	7,786	17,799	29,422	41,191	161,337
gross profit	9,950	22,746	37,599	52,638	206,173
other expenses and taxes	11,938	22,804	35,096	48,630	185,535
net profit	-1,988	-59	2,503	4,008	20,638
Balance Sheet					
cash	1,548	3,540	5,851	8,191	32,083
accounts receivable	650	1,486	2,457	3,439	13,471
cash plus accounts receivable	2,198	5,026	8,308	11,630	45,554
other current assets	958	2,190	3,620	5,069	19,853
total current assets	3,157	7,216	11,928	16,699	65,407
fixed assets	9,872	13,907	18,509	23,660	81,339
other non-current assets	2,207	5,045	8,340	11,676	45,732
total assets	15,236	26,168	38,777	52,035	192,478
accounts payable	394	900	1,487	2,082	8,154
loans payable	34	78	129	181	709
notes payable	1,911	2,502	3,169	3,951	13,032
other current liabilities	924	2,112	3,491	4,888	19,144
total current liabilities	3,263	5,591	8,277	11,101	41,038
non-current liabilities	8,114	10,758	13,754	17,231	57,296
total liabilities	11,377	16,349	22,031	28,332	98,334
net worth	3,859	9,819	16,746	23,703	94,145
capital	11,973	20,577	30,500	40,934	151,440
Total Liabilities and Net Worth	15,236	26,168	38,777	52,035	192,478

TABLE A-9. FINANCIAL STATEMENTS OF FIRMS IN ABOVE-AVERAGE FINANCIAL CONDITION: REGULATORY ALTERNATIVE II

Company Sales Range	$0-25K	$25-50K	$50-75K	$75-100K	$ >100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods	7,284	16,651	27,524	38,533	150,928
gross profit	10,452	23,894	39,497	55,296	216,582
other expenses and taxes	11,353	21,497	32,951	45,635	173,841
net profit	-901	2,397	6,546	9,661	42,741
Balance Sheet					
cash	1,379	3,152	5,211	7,295	28,574
accounts receivable	267	611	1,010	1,414	5,538
cash plus accounts receivable	1,646	3,763	6,221	8,709	34,112
other current assets	753	1,720	2,844	3,981	15,594
total current assets	2,399	5,484	9,065	12,691	49,706
fixed assets	9,033	11,989	15,338	19,222	63,954
other non-current assets	2,344	5,358	8,857	12,399	48,566
total assets	13,776	22,831	33,260	44,312	162,226
accounts payable	102	232	384	537	2,105
loans payable	9	20	33	47	183
notes payable	1,539	1,681	1,828	2,081	5,747
other current liabilities	238	545	901	1,262	4,942
total current liabilities	1,888	2,479	3,147	3,927	12,977
non-current liabilities	6,592	7,294	8,036	9,228	25,970
total liabilities	8,481	9,773	11,182	13,156	38,947
net worth	5,295	13,058	22,077	31,156	123,279
capital	11,888	20,352	30,113	40,384	149,249
Total Liabilities and Net Worth	13,776	22,831	33,260	44,312	162,226

TABLE A-10. FINANCIAL STATEMENTS OF FIRMS IN BELOW-AVERAGE FINANCIAL CONDITION: REGULATORY ALTERNATIVE III

Company Sales Range	$0-25K	$25-50K	$50-75K	$75-100K	$ >100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods	8,288	18,948	31,320	43,848	171,746
gross profit	9,448	21,597	35,701	49,981	195,764
other expenses and taxes	11,108	22,772	36,151	50,489	194,835
net profit	-1,660	-1,175	-450	-509	930
Balance Sheet					
cash	-6,386	-5,931	-5,360	-5,163	-8,747
accounts receivable	1,225	2,799	4,627	6,478	25,373
cash plus accounts receivable	-5,162	-3,132	-733	1,315	16,626
other current assets	924	2,112	3,490	4,887	19,140
total current assets	-4,238	-1,020	2,758	6,202	35,766
fixed assets	14,399	24,248	35,637	47,551	174,773
other non-current assets	2,255	5,154	8,520	11,928	46,718
total assets	12,415	28,382	46,915	65,680	257,257
accounts payable	665	1,520	2,513	3,518	13,779
loans payable	58	132	218	306	1,198
notes payable	795	1,817	3,004	4,206	16,474
other current liabilities	1,561	3,569	5,899	8,259	32,349
total current liabilities	3,079	7,039	11,635	16,289	63,800
non-current liabilities	4,370	9,990	16,514	23,119	90,554
total liabilities	7,449	17,029	28,149	39,408	154,354
net worth	4,966	11,353	18,766	26,272	102,903
capital	9,336	21,343	35,280	49,392	193,457
Total Liabilities and Net Worth	12,415	28,382	46,915	65,680	257,257

TABLE A-11. FINANCIAL STATEMENTS OF FIRMS IN AVERAGE FINANCIAL CONDITION: REGULATORY ALTERNATIVE III

Company Sales Range	$0-25K	$25-50K	$50-75K	$75-100K	$ >100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods	7,786	17,799	29,422	41,191	161,337
gross profit	9,950	22,746	37,599	52,638	206,173
other expenses and taxes	11,991	22,922	35,441	48,990	186,487
net profit	-2,041	-177	2,158	3,648	19,686
Balance Sheet					
cash	1,548	3,540	5,851	8,191	32,083
accounts receivable	650	1,486	2,457	3,439	13,471
cash plus accounts receivable	2,198	5,026	8,308	11,630	45,554
other current assets	958	2,190	3,620	5,069	19,853
total current assets	3,157	7,216	11,928	16,699	65,407
fixed assets	9,892	13,945	18,607	23,709	81,391
other non-current assets	2,207	5,045	8,340	11,676	45,732
total assets	15,256	26,207	38,875	52,084	192,530
accounts payable	394	900	1,487	2,082	8,154
loans payable	34	78	129	181	709
notes payable	1,916	2,510	3,190	3,962	13,043
other current liabilities	924	2,112	3,491	4,888	19,144
total current liabilities	3,267	5,600	8,298	11,112	41,049
non-current liabilities	8,131	10,792	13,843	17,274	57,342
total liabilities	11,399	16,392	22,141	28,386	98,391
net worth	3,857	9,815	16,735	23,698	94,139
capital	11,988	20,607	30,577	40,972	151,481
Total Liabilities and Net Worth	15,256	26,207	38,875	52,084	192,530

TABLE A-12. FINANCIAL STATEMENTS OF FIRMS IN ABOVE-AVERAGE FINANCIAL CONDITION: REGULATORY ALTERNATIVE III

Company Sales Range	$0-25K	$25-50K	$50-75K	$75-100K	$ >100K
Income Statement					
Sales	17,736	40,545	67,021	93,829	367,510
cost of goods	7,284	16,651	27,524	38,533	150,928
gross profit	10,452	23,894	39,497	55,296	216,582
other expenses and taxes	11,406	21,615	33,295	45,994	174,793
net profit	-954	2,279	6,202	9,302	41,790
Balance Sheet					
cash	1,379	3,152	5,211	7,295	28,574
accounts receivable	267	611	1,010	1,414	5,538
cash plus accounts receivable	1,646	3,763	6,221	8,709	34,112
other current assets	753	1,720	2,844	3,981	15,594
total current assets	2,399	5,484	9,065	12,691	49,706
fixed assets	9,053	12,027	15,437	19,271	64,006
other non-current assets	2,344	5,358	8,857	12,399	48,566
total assets	13,796	22,869	33,358	44,360	162,278
accounts payable	102	232	384	537	2,105
loans payable	9	20	33	47	183
notes payable	1,544	1,689	1,849	2,092	5,758
other current liabilities	238	545	901	1,262	4,942
total current liabilities	1,893	2,487	3,167	3,938	12,988
non-current liabilities	6,610	7,329	8,124	9,272	26,017
total liabilities	8,503	9,815	11,292	13,210	39,004
net worth	5,293	13,054	22,067	31,151	123,273
capital	11,903	20,382	30,191	40,423	149,290
Total Liabilities and Net Worth	13,796	22,869	33,358	44,360	162,278