Urban Pollution Soiling Damages and Damage Functions#

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I. INTRODUCTION

The effects of air pollution as all other externalities and their damages can be classified into three categories: (1) cost of direct effects, (2) adjustment costs, and (3) market effect costs. Estimates of damages to human health by Liu and Yu (1976) among others fall into the first category of direct cost effects of air pollution. The second category of adjustment costs of air pollution constitutes the main concern of this paper.

The best known and the pioneering contribution to the estimation of soiling loss due to air pollution was constructed by O'Connor (1913) for the Mellon Institute. The $20.00 per capita soiling cost figure estimated by O'Connor for the Pittsburgh smoke nuisance has been used as a basis for extrapolating to the $11 billion national damage estimate. The validity of this damage estimate, often quoted by public officials, has been questioned by Jones (1969) and others on the grounds that the underlying assumption of the estimates that the air pollution level in Pittsburgh is representative of the entire nation is questionable.

The two studies of quantifying the soiling costs in the Upper Ohio River Valley and Washington, D.C. carried out by Michelson and Tourin (1966, 1968) have also attracted public attention. Their methodology is based on the hypothesis that significant soiling due to air pollution may be reflected in shortened time intervals between successive cleaning and maintenance operations. Michelson and Tourin established a positive relationship between frequency of cleaning operations and the levels of air pollution in both studies. However, the problems with the sample survey design and the lack of a statistically reliable technique cast doubt on the reliability of their findings.

Ridker (1967) conducted interurban studies to determine the relationship between per capita soiling costs and air pollution level for 144 cities in the United States. Soiling damage costs were approximated by per capita expenditures on laundry and dry cleaning services. Ridker (1967) failed to

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detect discernable patterns between soiling costs and the suspended particulate levels whether the effects of climate, per capita income, and price differentials were controlled or not. The problem with the soiling damage estimates, as noted by Ridker himself arises from a rigid schedule for cleaning and maintenance operations and the schedule is independent of the location of the operation. This is especially true for commercial and industrial buildings. Additional problem arises from certain nonpollution factors which could not be controlled but these factors may be more important than air pollution in explaining the cleaning and maintenance procedures.

A recent study by Booz, Allen and Hamilton, Inc. (1970) has made a useful contribution to expand our knowledge about the relationship between cleaning frequency and suspended particulate levels. Specifically, the study reveals that 11 out of 27 ordinary cleaning and maintenance operations are sensitive to air-suspended particulate levels. In other words, the cleaning frequencies of about 40 percent of the major cleaning tasks are found to be positively related to the pollutant levels.

The objective of the paper is to quantify the soiling damages and to assign a monetary value to this category of pollution damages for the pollution-related cleaning operations as identified by the Booz, Allen and Hamilton researchers. A system of soiling physical damage functions which relate cleaning frequencies to air pollution levels for these pollution-related tasks will be developed. Furthermore, "average" economic damage functions for the United States metropolitan areas will be derived by relating monetary value of soiling damages to air pollution, demographic, socioeconomic, and climatological variables. It is hoped that the results presented in this paper are informative and useful for predicting pollution reduction benefits in terms of the resulting savings in the adjustment cost.

The plan of this paper is as follows: Section II contains the methodology and derivation of linear physical damage functions for depicting the effect of air suspended particulates on cleaning operation frequencies. In Section III, net as well as gross economic damages of soiling resulting from air pollution are estimated and presented separately for the 148 Standard Metropolitan Statistical Areas (SMSA's). Section IV develops economic damage functions for various types of household cleaning operations, and Section V contains the concluding remarks.

II. DEVELOPMENT OF SOILING PHYSICAL DAMAGE FUNCTIONS: DATA AND METHODOLOGY

Soiling is damages that result from total suspended particulates which accumulate from air pollution. It compels households, businesses, and industrial establishments to increase cleaning activities. Thus, soiling results in extra economic losses not only to households but to business and industrial firms as well. As noted above, a number of attempts have been undertaken to identify and quantify the soiling damages due to air pollution. Particularly noteworthy is a study by Booz, Allen and Hamilton, Inc.

(1970). This study provides, as a result of an extensive sample survey, the data base useful for developing the soiling physical damage functions, which relates physical damages of soiling to air pollution levels.

The Renjerdel area around Philadelphia, Pennsylvania, was selected as the data gathering area by the Booz-Allen researchers. Frequency of cleaning by the residents was determined by a carefully developed questionnaire containing queries regarding cleaning operations and a set of self-referent statements with respect to cleaning attitudes. Among the 27 cleaning and maintenance operations, the study shows that 11 were somewhat sensitive to air-suspended particulate levels. Of these 11 cleaning tasks, only 9 were considered in this study because of the lack of certain needed cost information. A list of these nine pollution-related cleaning tasks together with the information on "average" unit cleaning costs is contained in Table 1.

The methodology for developing a system of soiling physical damage functions is succinctly delineated as follows: First, four population "blocks" for each of the nine pollution-related cleaning task were constructed in the two-dimensional space involving pollution level and cleaning frequency. The Booz-Allen researchers divided the studied area into four separate zones according to the air pollution levels. The range of the annual average particulate levels X measured in terms of $\mu g/m^3$ in the four zones were given as follows: $X < 75$ in Zone 1; $75 < X < 100$ in Zone 2; $100 < X < 125$ in Zone 3 and $X > 125$ in Zone 4. In other words, the suspended particulate levels vary from 75 $\mu g/m^3$ to 100 $\mu g/m^3$ in Zone 2 and from 100 $\mu g/m^3$ to 125 $\mu g/m^3$ in Zone 3. The upper limit of the suspended particulates in Zone 1 is 75 $\mu g/m^3$ and the lower limit of X in Zone 4 is 125 $\mu g/m^3$. It is reasonable to assume that the suspended particulate level in the study area ranges from a lower limit of 25 $\mu g/m^3$ to an upper limit of 175 $\mu g/m^3$. Therefore, the pollutant level in Zone 1 would vary between 25 $\mu g/m^3$ to 75 $\mu g/m^3$ and in Zone 4 would vary between 125 $\mu g/m^3$ to 175 $\mu g/m^3$. For convenience sake, the ranges of air pollution levels for the four sampling zones are tabulated in Table 2.

TABLE 1

Pollution-Related Tasks and Their Unit Cleaning Costs

	Tasks	Unit Cleaning Costs ($)
1	Replace air conditioner filter	1.00
2	Wash floor surface	6.00
3	Wash inside window	0.50
4	Clean venetian blinds/shades	3.50
5	Clean/repair screens	0.20
6	Wash outside windows	1.50
7	Clean/repair storm windows	2.00
8	Clean outdoor furniture	10.00
9	Clean gutters	15.00

Second, the range values of cleaning frequency (Y) for the four zones were computed by adding and subtracting one standard error of the mean from the mean value of the cleaning frequency. The computed values for lower limit (Min Y) and upper limit of the cleaning frequency (Max Y), lower limit (Min X) and upper limit (Max X) of suspended particulates, coupled with the mean frequency of cleaning and the standard error of the means for the nine pollution-related tasks are presented in Appendix A. The pollution and cleaning frequency "blocks" on which the sampling experiment is conducted are bounded by the values of Min Y, Max Y, Min X and Max X.

Third, a sampling technique was applied to the four "blocks" associated with the four zones for each cleaning task. It should be pointed out that the purpose of the sampling experiment is not to force a correlation between cleaning frequency and pollution level (the correlation has already been confirmed by the prior Booz, Allen and Hamilton study), but to generate a larger set of random observations to account for possible uncertainty associated with the original data. As a result, a random sample of 160 random observations for each cleaning task was selected for regression analysis. These 160 observations were fitted via both linear and nonlinear least-squares techniques. It was found that the linear fit is superior than the nonlinear fit in all cases of cleaning operations except for Task 8. Assembling the best set of the regression results, the linear regressions for Task 1 through 7 and Task 9 and the nonlinear regression for Task 8 are summarized in Table 3. It is noteworthy that the coefficients for pollution variable are significant at the 1 percent level for all 9 cleaning operations, and the R^2 ranges from 0.43 to 0.80 for the 8 linear physical damage functions and 0.26 for the nonlinear equation.

III. SOILING ECONOMIC DAMAGES OF AIR POLLUTION

Given the preceding nine physical damage functions for the nine pollution-related cleaning tasks and the associated unit cleaning costs which were obtained through telephone conversations with various cleaning firms in Kansas City, the economic costs of individual household adjustment to air pollution can be derived by transforming the pollution-induced cleaning frequency into monetary units, via the following two formulas:[1]

TABLE 2

Ranges of Air Pollution Levels ($\mu g/m^3$) in the Four Study Areas

	Min X	Max X
Zone 1	25	75
Zone 2	75	100
Zone 3	100	125
Zone 4	125	175

$$NSCO_i = b_i(TSP\text{-}45) \cdot C \cdot U \cdot H \quad (7)$$

$$GSCO_i = a_i + b_i\,(TSP\text{-}45) \cdot C \cdot U \cdot H \quad (8)$$

where $NSCO_i$ and $GSCO_i$ are, respectively, the net (extra) and gross soiling damage cost for the ith type of cleaning task. Parameters a_i and b_i ($i=1, \ldots, 9$) are the estimated coefficients in the physical damage functions as shown in Table 3. Variables C, U and H stand for the unit cleaning cost, number of cleaning objects per household and number of households in a metropolitan area, respectively.

To measure the "real" effect of suspended particulates on soiling damages, the suspended particulate level was adjusted by a threshold level because a low level of suspended particulate might have a negligible effect on the household cleaning activities. A threshold level of 45 $\mu g/m^3$ for suspended particulate was assumed as the background concentration level in this study because the lowest 1970 annual mean level for total suspended particulates was 46.7 $\mu g/m^3$ for Charleston, South Carolina. Alternative reasonable threshold levels can also be used for estimating soiling costs. It

TABLE 3

Soiling Physical Damage Functions[a/]

Task	a	b	R^2
	A. Frequency = a + b TSP		
1	0.03 (0.05)	0.00510 (0.00048)*	0.43
2	38.6 (0.18)	0.0400 (0.0017)*	0.80
3	5.6 (0.4)	0.078 (0.036)*	0.76
4	2.3 (0.2)	0.048 (0.002)*	0.79
5	0.42 (0.06)	0.0059 (0.0049)*	0.48
6	1.00 (0.28)	0.0530 (0.0025)*	0.74
7	0.85 (0.15)	0.015 (0.001)*	0.48
9	0.27 (0.12)	0.0140 (0.0011)*	0.55
	B. Frequency = $c + e^{(a-b/TSP)}$		
8 (c = 2)	0.67 (0.10)	53.2 (7.4)*	0.26

a/ The values below the coefficients are standard errors, with * to indicate that the coefficient is significant at the 1 percent level.

is worth pointing out that, other things being equal, a higher threshold level is generally associated with a lower damage cost, and the marginal changes in the damage cost in response to a unit change in the threshold level is the value of b_i for the ith type of cleaning task.

Given the data collected from official publications and telephone interviews for the variables in the formulae (7) and (8), the net and gross household soiling costs for each of the nine cleaning operations by the 65 large SMSA's (with population greater than 500,000) and by the 83 medium SMSA's (200,000 to 500,000 people) were derived.[2] The detailed soiling damage estimates by cleaning operations and SMSA's will be furnished upon request from the readers. The findings reveal that Chicago, New York, and Los Angeles, in order of magnitude, suffered the most in terms of total net soiling damages. The net soiling damages in these three SMSA's in 1970 are, respectively, $516 million, $418 million, and $388 million. It is also noteworthy that the cleaning activities of Tasks 4 and 6 resulted in an economic damage of about $2 billion and $1 billion, respectively, in the 148 metropolitan areas. These two tasks constituted the largest damage categories among the nine pollution-related cleaning tasks.

Per capita net and gross soiling damage costs in the presence of air pollution for large SMSA's and medium SMSA's for 1970 were also computed. The per capita cost figures, available to readers upon request, indicate that the soiling damages attributable to air pollution in large SMSA's range from $5 per person in San Antonio, Texas, to $104 per person in Cleveland, Ohio, whereas the net soiling damages in medium SMSA's vary from less than a dollar per person in Charleston, South Carolina, to $67.35 per person in Wichita, Kansas. These damage estimates of soiling for individual SMSA's appear to be much more realistic than the overall per capita damage estimates of $20.00 by Mellon Institute and of $200 by Michelson and Tourin.

A summary of the net and gross soiling damages by cleaning operations is contained in Table 4. The total net soiling damage as a result of falling suspended particulates for the 148 SMSA's in 1970 amounts to $5 billion. This damage figure is far smaller than the $11 billion and $30 billion national estimate extrapolated from the per capita damage figures reported respectively in the Mellon Institute study and the study by Michelson and Tourin. The validity of the $11 billion and $30 billion estimates, as noted earlier, are seriously undermined by the assumptions used in the extrapolation. Regarding the gross soiling damage costs, New York, Chicago and Los Angeles had the highest damages among the 148 large SMSA's, about $1.6 billion, $1.2 billion, and $1.1 billion, respectively, partially because of the relatively high suspended particulate levels and a large number of household units in these three cities. Total gross soiling damage which is the sum of soiling damages attributable to air pollution and other factors amounts to $17.4 billion per year for the 148 SMSA's.

Regarding the use of the regional soiling damage costs and the national damage costs derived in this study, a caveat is in order. The damage costs should be used only as crude estimates because of the possible violation of the two assumptions employed in our model: (1) the physical damage functions developed for the Philadelphia area are "representative" of the physical damage functions of the 148 SMSA's; (2) the unit cleaning cost figures obtained in the Kansas City area are applicable to other SMSA's.

IV. SOILING ECONOMIC DAMAGE FUNCTIONS

In order to develop "average" soiling economic damage functions for each of the nine cleaning tasks, the individual metropolitan damage costs were regressed against not only the TSP, but also to various socioeconomic, demographic, and climatological characteristics of various regions. The stepwise regression technique was used with inputs from the 148 sample observations for estimating the economic damage functions. The regression results are summarized in Table 5. The variable $GSCO_i$ denotes the gross soiling damage cost of the ith type of the cleaning operation, i=1, 2, ... , 9. TGSCO is the total gross soiling cost, i.e., the sum of $GSCO_i$ over i. Seven independent variables were selected to represent the socioeconomic, demographic and climatological characteristics. The variable MANFV denotes the value of manufacturing output, TSP the total suspended particulate level ($\mu g/m^3$), PCOL the percentage of persons 25 or older who have completed 4 years of college, RHM the relative humidity, DTS the numbers of days with thunderstorms, PDS, the population density in the SMSA, PAGE the percentage of population that is more than 65 years old and the parameter a is the intercept. It is noteworthy that all the coefficients of TSP are of correct signs except the one in the second regression equation. Since the partial correlation coefficient between GSCO2 and TSP is positive and equal to 0.18, the negative coefficient obtained for TSP in the regression equation may be attributable to multicolinearity and other econometric problems.

The soiling economic damage functions derived here are useful to

TABLE 4
Net and Gross Soiling Damage Costs in 148 SMSA's by Cleaning Operations, 1970

Tasks	Net Soiling Damages (million $)	Gross Soiling Damages (million $)	Net/Gross Soiling Damages Cost
1	11.8	12.8	0.91
2	558.8	9,884.9	0.05
3	454.1	204.0	0.45
4	1,956.3	3,584.1	0.55
5	13.6	30.6	0.44
6	925.7	1,227.9	0.75
7	349.2	691.6	0.50
8	275.1	1,079.2	0.25
9	488.9	652.0	0.75
Total	5,033.0	17,367.1	0.28

TABLE 5

Soiling Economic Damage Functions[a]

Dependent Variable	MANFV	TSP	PCOL	RHM	DTS	PDS	PAGE	a	R^2
GSC01	66.18	1,128.83	2,377.55	-995.17	271.69	-1.78	764.7	-100,181.3	0.92
	(2.02)*	(147.36)*	(1,288.8)	(538.89)	(193.52)	(3.81)	(1,940.9)	(46,192.6)	
GSC02	42.9	-108.5	2,252.2	670.6		2.2	2,401.1	5,400.0	0.89
	(1.45)*	(105.5)	(915.7)*	(383.4)		(2.7)	(1,392.6)	(32,763.0)	
GSC03	957.6	6,802.6	42,426.0	-14,677.0	1,946.0	12.4	32,626.0	652,046.0	0.93
	(25.9)*	(1,887.5)*	(16,507.0)*	(6,902.0)*	(2,478.0)	(48.9)	(24,859.0)	(591,650.0)	
GSC04	17.2	160.0	727.4	-262.6	42.577		501.9	14,825.0	0.93
	(0.42)*	(33.1)*	(292.3)*	(122.4)*	(43.8)		(439.4)	(10,445.0)	
GSC05	144.3	1,031.6	6,384.9	-2,210.7	294.6	1.85	4,898.9	98,799.0	0.93
	(3.90)*	(284.2)*	(2,485.6)*	(1,039.3)*	(373.2)	(7.36)	(3,743.2)	(89,087.0)	
GSC06	6.12	84.0	236.9	-92.6	20.9	-0.083	116.6	-7,565.5	0.93
	(0.17)*	(12.5)*	(109.9)*	(45.9)*	(16.5)	(0.325)	(165.6)	(3,941.2)	
GSC07	3.29	27.7	142.0	-50.3	7.6	0.025	102.2	-2,607.0	0.93
	(0.08)*	(6.4)*	(56.3)*	(23.5)*	(8.4)	(0.166)	(84.8)	(2,018.7)	
GSC08	4.92	9.07	223.0	-74.8		0.17	212.9	877.7	0.91
	(0.15)*	(10.9)	(94.9)*	(39.7)		(0.28)	(144.4)	(3,396.3)	
GSC09	3.23	44.6	126.9	-48.9	11.2		60.4	4,047.7	0.93
	(0.08)*	(6.5)*	(579.4)*	(24.2)*	(8.6)		(87.0)	(2,070.1)	
TGSCO[b]	78.9	226.4	3,766.0	-1,219.8	90.9	2.3	3,432.3	-25,621.0	0.92
	(2.3)*	(166.9)	(1,460.0)*	(610.7)*	(219.3)	(4.3)	(2,199.5)	(52,347.0)	

a /All coefficients and standard errors are reduced by a factor of 10^3, except equation GSC01, GSC03 and GSC05. The standard errors are the values below the coefficients, and * indicates that the coefficient is significant at the 1 percent level.

policy-makers at either the local or national level in estimating the marginal and average benefits of implementing pollution abatement programs. The responsiveness of gross soiling damages for a particular cleaning task to changes in climatological, demographic, and socioeconomic variables and the concentration level of suspended particulates can be easily estimated. Of particular policy interest is the estimation of possible benefit in terms of the reduction in the overall soiling damage cost as a result of a pollution control program. Note that the coefficient of TSP in the overall soiling economic damage function is 226,400 and the mean value of overall soiling damage is \$117.3 million. Given that the mean value of TSP = 94.5 $\mu g/m^3$, the elasticity of soiling cost with respect to pollution level is computed as follows:

$$E_{SC,TSP} = 226400 \text{ x } (94.5/117.3000000) = 0.18$$

Thus, if the suspended particulate level is lowered, on the average, by 10 percent, from 94.5 to 85.5 $\mu g/m^3$, overall gross soiling damage cost would reduce by 1.8 percent or by \$2.1 million, from \$117.3 million to \$115.2 million.

V. CONCLUDING REMARKS

An attempt has been in the preceding analysis to develop a system of soiling physical damage functions by relating nine types of cleaning frequencies to air pollution. Furthermore, national "average" economic damage functions for various household soiling chores were developed by regressing soiling damages to air pollution and other relevant demographic, socioeconomic, and climatological variables. Based on the physical and the economic pollution soiling damage functions, the net and gross soiling damage costs for the 148 selected SMSA's with population exceeding 250,000 were estimated. We found that total net soiling costs attributable to air pollution over the 148 SMSA's amounted to more than \$5 billion, and total gross soiling costs were about \$17 billion over the 148 SMSA's. An example involving the calculation of the pollution elasticity of household soiling damages is given to illustrate the use of the economic damage function for predicting possible benefits of various pollution control programs. It is shown that a 10 percent reduction in the urban suspended particulate level would result in a saving of exceeding 2 million dollars in the United States.

FOOTNOTES

[1]For Task 8, $NSCO8 = e^{0.85 - 0.015/(TSP - 45)} \cdot C \cdot U \cdot H$ and

$$GSCO8 = 2 + e^{0.85 - 0.015/(TSP - 45)} \cdot C \cdot U \cdot H$$

[2]For a detailed listing of the 148 large and medium SMSA's included in this study, see Appendix B.

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APPENDIX A

Mean Frequency, Standard Error and Upper And Lower Limits of Frequency And Suspended Particulates

	Mean Frequency of Cleaning	Standard Error of Means	Min Y	Max Y	Min X	Max X
Task 1						
Zone 1	0.36	0.06	0.30	0.42	25	75
Zone 2	0.50	0.08	0.42	0.58	75	100
Zone 3	0.30	0.07	0.23	0.37	100	125
Zone 4	0.98	0.34	0.64	1.32	125	175
Task 2						
Zone 1	40.55	0.84	39.71	41.39	25	75
Zone 2	42.06	0.84	41.22	42.90	75	100
Zone 3	42.74	0.98	41.77	43.72	100	125
Zone 4	45.17	0.93	44.24	46.10	125	175
Task 3						
Zone 1	10.06	0.61	9.45	10.17	25	75
Zone 2	11.78	0.70	11.08	12.48	75	100
Zone 3	12.74	0.82	11.93	13.55	100	125
Zone 4	18.45	1.10	17.85	20.05	125	175
Task 4						
Zone 1	4.04	0.53	3.51	4.57	25	75
Zone 2	6.17	0.66	5.51	6.87	75	100
Zone 3	9.13	0.91	8.22	10.04	100	125
Zone 4	9.21	0.49	8.22	10.20	125	175
Task 5						
Zone 1	0.80	0.07	0.75	0.87	25	75
Zone 2	0.93	0.16	0.77	1.09	75	100
Zone 3	0.79	0.10	0.70	0.86	100	125
Zone 4	1.50	0.32	1.18	1.82	125	175
Task 6						
Zone 1	4.25	0.35	3.90	4.60	25	75
Zone 2	4.59	0.38	4.21	4.97	75	100
Zone 3	6.17	0.60	5.57	6.77	100	125
Zone 4	10.09	0.88	9.21	10.97	125	175

APPENDIX A (Concluded)

	Mean Frequency of Cleaning	Standard Error of Means	Min Y	Max Y	Min X	Max X
Task 7						
Zone 1	2.07	0.28	1.79	2.35	25	75
Zone 2	1.60	0.23	1.37	1.83	75	100
Zone 3	2.12	0.39	1.73	2.51	100	125
Zone 4	3.69	0.63	3.60	4.32	125	175
Task 8						
Zone 1	2.50	0.45	2.05	2.95	25	75
Zone 2	4.29	0.65	3.64	4.94	75	100
Zone 3	3.52	0.71	2.81	4.23	100	125
Zone 4	1.19	0.47	0.72	1.66	125	175
Task 9						
Zone 1	1.12	0.22	0.91	1.34	25	75
Zone 2	1.54	0.33	1.21	1.87	75	100
Zone 3	1.35	0.44	0.91	1.79	100	125
Zone 4	2.80	0.69	2.11	3.49	125	175

APPENDIX B

SMSA'S with Population over 500,000 (L)

	SMSA	Code	Population, 1970 (in 1,000)
1	Akron, Ohio	AKR	679
2	Albany-Schenectady-Troy, N.Y.	ALB	721
3	Allentown-Bethlehem-Easton, Pa.-N.J.	ALL	544
4	Anaheim-Santa Ana-Garden Grove, Calif.	ANA	1,420
5	Atlanta, Ga.	ATL	1,390
6	Baltimore, Md.	BAL	2,071
7	Birmingham, Ala.	BIR	739
8	Boston, Mass.	BOS	2,754
9	Buffalo, N.Y.	BUF	1,349
10	Chicago, Ill.	CHI	6,979
11	Cincinnati, Ohio-Ky.-Ind.	CIN	1,385
12	Cleveland, Ohio	CLE	2,064
13	Columbus, Ohio	COL	916
14	Dallas, Texas	DAL	1,556
15	Dayton, Ohio	DAY	850
16	Denver, Colo.	DEN	1,228
17	Detroit, Mich.	DET	4,200
18	Fort Lauderdale-Hollywood, Fla.	FOR	620
19	Fort Worth, Texas	FOR	762
20	Gary-Hammond-East Chicago, Ind.	GAR	633
21	Grand Rapids, Mich.	GRA	539
22	Greensboro-Winston-Salem-High Point, N.C.	GRE	604

APPENDIX B

SMSA'S with Population over 500,000 (L)

	SMSA	Code	Population, 1970 (in 1,000)
23	Hartford, Conn.	HAR	664
24	Honolulu, Hawaii	HON	629
25	Houston, Texas	HOU	1,985
26	Indianapolis, Ind.	IND	1,110
27	Jacksonville, Fla.	JAC	529
28	Jersey City, N.J.	JER	609
29	Kansas City, Mo.-Kans.	KAN	1,254
30	Los Angeles-Long Beach, Calif.	LOS	7,032
31	Louisville, Ky.-Ind.	LOU	827
32	Memphis, Tenn.-Ark.	MEM	770
33	Miami, Fla.	MIA	1,268
34	Milwaukee, Wis.	MIL	1,404
35	Minneapolis-St. Paul, Minn.	MIN	1,814
36	Nashville-Davidson, Tenn.	NAS	541
37	New Orleans, La.	NEW	1,046
38	New York, N.Y.	NEW	11,529
39	Newark, N.J.	NEW	1,857
40	Norfolk-Portsmouth, Va.	NOR	681
41	Oklahoma City, Okla.	OKL	641
42	Omaha, Nebraska-Iowa	OMA	540
43	Paterson-Clifton-Passaic, N.J.	PAT	1,359
44	Philadelphia, Pa.-N.J.	PHI	4,818
45	Phoenix, Ariz.	PHO	968
46	Pittsburgh, Pa.	PIT	2,401
47	Portland, Oreg.-Wash.	POR	1,009
48	Providence-Pawtucket-Warwick, R.I. -Mass.	PRO	911
49	Richmond, Va.	RIC	518
50	Rochester, N.Y.	ROC	883
51	Sacramento, Calif.	SAC	801
52	St. Louis, Mo.-Ill.	STL	2,363
53	Salt Lake City, Utah	SAL	558
54	San Antonio, Texas	SAN	864
55	San Bernadino-Riverside-Ontario, Calif.	SAN	1,143
56	San Diego, Calif.	SAN	1,358
57	San Francisco-Oakland, Calif.	SAN	3,110
58	San Jose, Calif.	SAN	1,065
59	Seattle-Everett, Wash.	SEA	1,422
60	Springfield-Chicopee-Holyoke, Mass.-Conn.	SPR	530
61	Syracuse, N.Y.	SYR	636
62	Tampa-St. Petersburg, Fla.	TAM	1,013
63	Toledo, Ohio-Mich.	TOL	693
64	Washington, D.C.-Md.-Va.	WAS	2,861
65	Youngstown-Warren, Ohio	YOU	536

APPENDIX B

SMSA'S with Population 200,000-500,000 (M)

	SMSA	Code	Population, 1970 (in 1,000)
66	Albuquerque, N. Mex	ALB	316
67	Ann Arbor, Mich.	ANN	234
68	Appleton-Oshkosh, Wis.	APP	277
69	Augusta, Ga.-S.C.	AUG	253
70	Austin, Texas	AUS	296
71	Bakersfield, Calif.	BAK	329
72	Baton Rouge, La.	BAT	285
73	Beaumont-Port Authur-Orange, Texas	BEA	316
74	Binghamton, N.Y.-Pa.	BIN	303
75	Bridgeport, Conn.	BRI	389
76	Canton, Ohio	CAN	372
77	Charleston, S.C.	CHA	304
78	Charleston, W. Va.	CHA	230
79	Charlotte, N.C.	CHA	409
80	Chattanooga, Tenn.-Ga.	CHA	305
81	Colorado Springs, Colo.	COL	236
82	Columbia, S.C.	COL	323
83	Columbus, Ga.-Ala.	COL	239
84	Corpus Christi, Texas	COR	285
85	Davenport-Rock Island-Moline, Iowa-Ill.	DAV	363
86	Des Moines, Iowa	DES	286
87	Duluth-Superior, Minn.-Wis.	DUL	265
88	El Paso, Tex.	ELP	359
89	Erie, Pa.	ERI	264
90	Eugene, Oreg.	EUG	213
91	Evansville, Ind.-Ky.	EVA	233
92	Fayetteville, N.C.	FAY	212
93	Flint, Mich.	FLI	497
94	Fort Wayne, Ind.	FOR	280
95	Fresno, Calif.	FRE	413
96	Greenville, S.C.	GRE	300
97	Hamilton-Middleton, Ohio	HAM	226
98	Harrisburg, Pa.	HAR	411
99	Huntington-Ashland, W. Va.-Ky.-Ohio	HUN	254
100	Huntsville, Ala.	HUN	228
101	Jackson, Miss.	JAC	259
102	Johnstown, Pa.	JOH	263
103	Kalamazoo, Mich.	KAL	202
104	Knoxville, Tenn.	KNO	400
105	Lancaster, Pa.	LAN	320
106	Lansing, Mich.	LAN	378
107	Las Vegas, Nev.	LAS	273
108	Lawrence-Haverhill, Mass.-N.H.	LAW	232
109	Little Rock-North Little Rock, Ark.	LIT	323

APPENDIX B (Concluded)

SMSA'S with Population 200,000-500,000 (M)

	SMSA	Code	Population, 1970 (in 1,000)
110	Lorain-Elyria, Ohio	LOR	257
111	Lowell, Mass.	LOW	213
112	Macon, Ga.	MAC	206
113	Madison, Wis.	MAD	290
114	Mobile, Ala.	MOB	377
115	Montgomery, Ala.	MON	201
116	New Haven, Conn.	NEW	356
117	New London-Groton-Norwich, Conn.	NEW	208
118	Newport News-Hampton, Va.	NEW	292
119	Orlando, Fla.	ORL	428
120	Oxnard-Ventura, Calif.	OXN	376
121	Pensacola, Fla.	PEN	243
122	Peoria, Ill.	PED	342
123	Raleigh, N.C.	RAL	228
124	Reading, Pa.	REA	296
125	Rockford, Ill.	ROC	272
126	Saginaw, Mich.	SAG	220
127	Salinas-Monterey, Calif.	SAL	250
128	Santa Barbara, Calif.	SAN	264
129	Santa Rosa, Calif.	SAN	205
130	Scranton, Pa.	SCR	234
131	Shreveport, La.	SHR	295
132	South Bend, Ind.	SOU	280
133	Spokane, Wash.	SPO	287
134	Stamford, Conn.	STA	206
135	Stockton, Calif.	STO	290
136	Tacoma, Wash.	TAC	411
137	Trenton, N.J.	TRE	304
138	Tucson, Ariz.	TUC	352
139	Tulsa, Okla.	TUL	477
140	Utica-Rome, N.Y.	UTI	340
141	Vallejo-Napa, Calif.	VAL	249
142	Waterbury, Conn.	WAT	209
143	West Palm Beach, Fla.	WES	349
144	Wichita, Kans.	WIC	389
145	Wilkes-Barre-Hazleton, Pa.	WIL	342
146	Wilmington, Del.-N.J.-Md.	WIL	499
147	Worcester, Mass.	WOR	344
148	York, Pa.	YOR	330