Environmental interregional input-output models

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Pollution problems have become of increasing concern to policy makers in most industrialized countries. In the United States, pollution issues are handled at the national level primarily by the U. S. Environmental Protecion Agency (EPA). Many different state, regional, and private groups are also concerned with pollution, such as state environmental agencies, the Sierra Club, the Audubon Society, etc. Currently, there are regulations for air, water, and solid waste. The main purpose of this paper is to review an analysis conducted in 1979 by Pai, who examined the economic impacts of the regulations imposed under the 1974 Clear Air Act. Pai extended the Leontief (1970) national environmental model to the regional level to account for the interregional and interindustrial economic impacts of these national environmental regulations. To accomplish this, he modified the multiregional input-output (MRIO) model that had been developed under the direction of Polenske (1970). He used the modified MRIO model to determine both the gains in output created by investment in pollution-abatement technology and the losses in output to be expected from the price effects of emission control. The regions and industries that benefit from the additional investment are generally not the same as those that must internalize the costs.

Between 1971 an 1977, 109 plants closed in the United States, leaving 20,517 employees without jobs as a result of what were claimed to be environmentally related causes. These closings were concentrated in four industries: primary metals, food, chemicals, and pulp and paper. Although the number of plant closings and job losses was relatively small, the number would certainly increase with stricter enforcement. Pollution-abatement expenditures in 1975 were $29.2 billion and in 1976 $32.8 billion, representing approximately two percent of the gross national product (GNP). During this part of the 1970s, pollution-abatement expenditures were increasing at about 10-11 percent per year.

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Pai's (1979) model was formulated to be directly applicable for policy analyses. This is in contrast to the models formulated by Ayres and Kneese (1969) and Cumberland (1966). Ayres and Kneese recognized that their model was almost impossible to implement because of the data collection and computational problems (1969, p. 295). Cumberland fails to account for the relationship between economic activity and net environmental repercussions. His model can therefore mainly be used as an accounting device; however, it should be noted that it does not contain an internal consistency in the accounting units.

Daly (1968) also constructed a model that failed to maintain an internal accounting consistency. No market prices can be attributed to the ecological commodities. Isard et al. (1968) overcame some of the problems with Daly's model by using a commodity-by-industry set of input-output accounts instead of an industry-by-industry set. Again, however, the data for the ecological sector are nonexistant. In both models, pollutant discharges into the environment are associated with the economic outputs, while the inputs from the environment are treated as part of the industrial inputs.

Leontief (1970) reversed these relationships. In his model, the amount of pollution produced by each industry is assumed to be a function of the total output of the industry, while the inputs required to produce antipollution goods becomes part of the costs of production. In contrast to Isard et al. and Daly, Leontief therefore treats the latter as part of the intermediate, rather than final, demand. Although Leontief omits the environmental sector by this reversal, the antipollution industry is introduced, which allows economic impacts to be determined. All of the other models tend to have an environmental bias. The analysts were concerned with the generation of pollution and its costs to the environment, rather than with the costs and benefits to the economy, as measured by the direct and indirect changes in output, employment, interregional trade, investment, thus changes in economic growth of regions and industries.

Pai (1979) examined these economic costs and benefits by extending the Leontief model to the interregional level and then examining the inflationary impacts and regional disparities that would result from the implementation of the 1974 Clean Air regulations at an arbitrarily chosen level of control. To implement the model, he expanded the Leontief model to a multiregional level. The Leontief model is shown in Figure 1. He used both the primal and the dual form of the MRIO model. The MRIO data for 1963 were aggregated from 79 industries and 51 regions to 19 industries and 9 regions. For each round of calculations, the MRIO model was partially closed with respect to households; thus, wages and salaries of these households are shown as the 20th industry in each of the following tables.

In addition to the MRIO 1963 data, three other sets of data were obtained, namely emission coefficients, abatement-cost coefficients, and data to construct the λs, where the latter are calculated as the proportion of the total amount of pollution generated by an industry that is removed by the same industry. These data were provided by the Resources for the Future (RFF). There were obtained from their ORSA, B.74 version of the Strategic Environmental Assessment (SEAS) model, which used 1975 base-year data to project industrial-output, emissions-generation, and emissions-abatement data for 1971, 1975, 1985, 2000, 2010, and 2025, assuming the 1974 performance standards would be implemented by states by 1977. Data were supplied for particulates, sulfur oxides, nitrogen oxides, hyrdocarbons, and carbon monoxide. Their 1985 data were selected for the present study. In addition, staff at the Interindustry Forecasting at the University of Maryland

(INFORUM) project, working under the direction of Almon, provided the price-elasticity data from their INFORUM model.

To implement the model, three assumptions were made in addition to the usual input-output assumptions.

1. Pollution is not traded from region to region.
2. Pollution generated bu the pollution-abatement sector is zero.
3. The emission coefficient for each industry equals the coefficient times λ, where λ varies between 0 and 1 depending upon the exogenous variable under consideration.

The relationships among these data are shown in Figure 2.

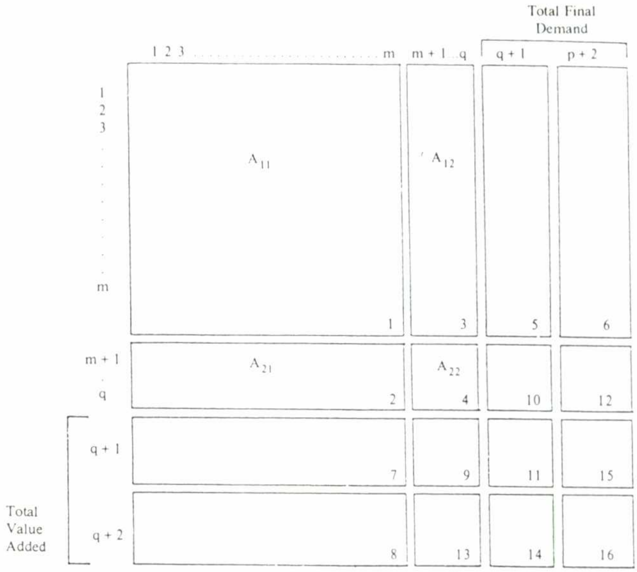
The λs were calculated by determining for each industry the total emission of the 5 pollutants generated and dividing this total into the figure for the total emissions abated. Ratios for this variable ranged from a low of .27 for the food industry to a high of .98 for the primary nonferrous metal manufacturers, with a weighted average of .90. The emissions coefficients were calculated for each industry by dividing the tons of the total of the 5 pollutants emitted on an annual basis by the thousands of dollars of output. These coefficients were zero for agriculture, construction, and a few other industries, and ranged from a low of 0.0003 for machinery and equipment to a high of 2.0098 for electric utilities. The abatement-cost coefficients were calculated for each industry by dividing the thousands of dollars spent on pollution abatement on an annual basis by the tons of pollution abated. These were zero for all agricultural, mining, and construction industries and ranged from a low of 0.0013 for primary iron and steel manufacturers to a high of 48.8774 for machinery and equipment. Because of lack of data, the same coefficients were used for each region.

Figure 3 illustrates how the calculations were made. Relative prices were calculated using the MRIO price model (Table 1). These changes in relative prices were then used to adjust the consumption expenditures, and a partially-closed-with-respect-to-households version of the MRIO model was implemented to determine the changes in output resulting from the price effects (Table 2). The pollution-abatement expenditures were allocated to regions, and the partially closed model was again used to determine output changes resulting from the increased expenditures (Table 3). Finally, the two effects were summed to obtain the net effect (Table 4).

As can be seen from the tables, a number of conclusions can be drawn from this study. For the economy as a whole output would increase by about 1.4 percent, or approximately 20 billion dollars by the implementation of the clean air standards. Some industries and regions benefits and others lose. Industries with significant linkages to the production of abatement technology, especially the machinery and equipment industries, showed the largest increases in output. If industries were either large polluters but had low linkages to the abatement industry or if they were industries that were strongly affected by the induced expenditures in consumption expenditures, they experienced low increases in output. It is interesting to note that although petroleum is one of the largest pollution industries, it had substantial gains in output because of the strong link with abatement expenditures.

At the regional level, the main result is that the implementation of the stricter environmental controls would aid the industrialized, older regions of the country the most. This occurs even though these regions in the East also had higher levels of industrial pollution. As noted, the model formulated by Pai is based upon the MRIO model. The basic framework could be adapted for use investigating water-pollution, acid-rain, and other environmental issues at a detailed regional and industrial level.

Figure 1: The Leontief input-output accounting system with pollution sectors included



1. Matrix of interindustry coefficients, in value terms (mxm).

2. Matrix of pollution output per unit of industrial output, in physical terms (qxm),

3. Matrix of pollution-abatement expenditures per unit of industrial pollution eliminated, in valur terms (mxp),

4. Matrix of pollution output per unit of pollution eliminated, in physical terms (qxq),

5. Personal consumption expenditures per unit of total personal consumption in value terms (mxl),

6. Other final demand per unit of total output of the other final demand sectors, in value terms (mxl),

7. Wages and salaries per unit of output, in value terms (lxm),

8. Other value added per unit of output, in value terms (lxm),

9. Wages and salaries expended per unit of pollution eliminated, in value terms (lxq),

10. Pollution output per unit of personal consumption expenditure, in physical terms (qxl),

11. Wages and salaries per unit of personal consumption expenditure, in value terms (lxl),

12. Pollution output per unit of output of other final demand sectors, in physical terms (qxl),

13. Other value added expended per unit of pollution eliminated, in value terms (lxq),

14. Other value added per unit of personal consumption expenditure, in value terms (lxl),

15. Wages and salaries per unit of output of other final demand sectors, in value terms (lxl), and.

16. Other value added per unit of output of other final demand sectors, in value terms (lxl).

Figure 2. Data relationships in the model

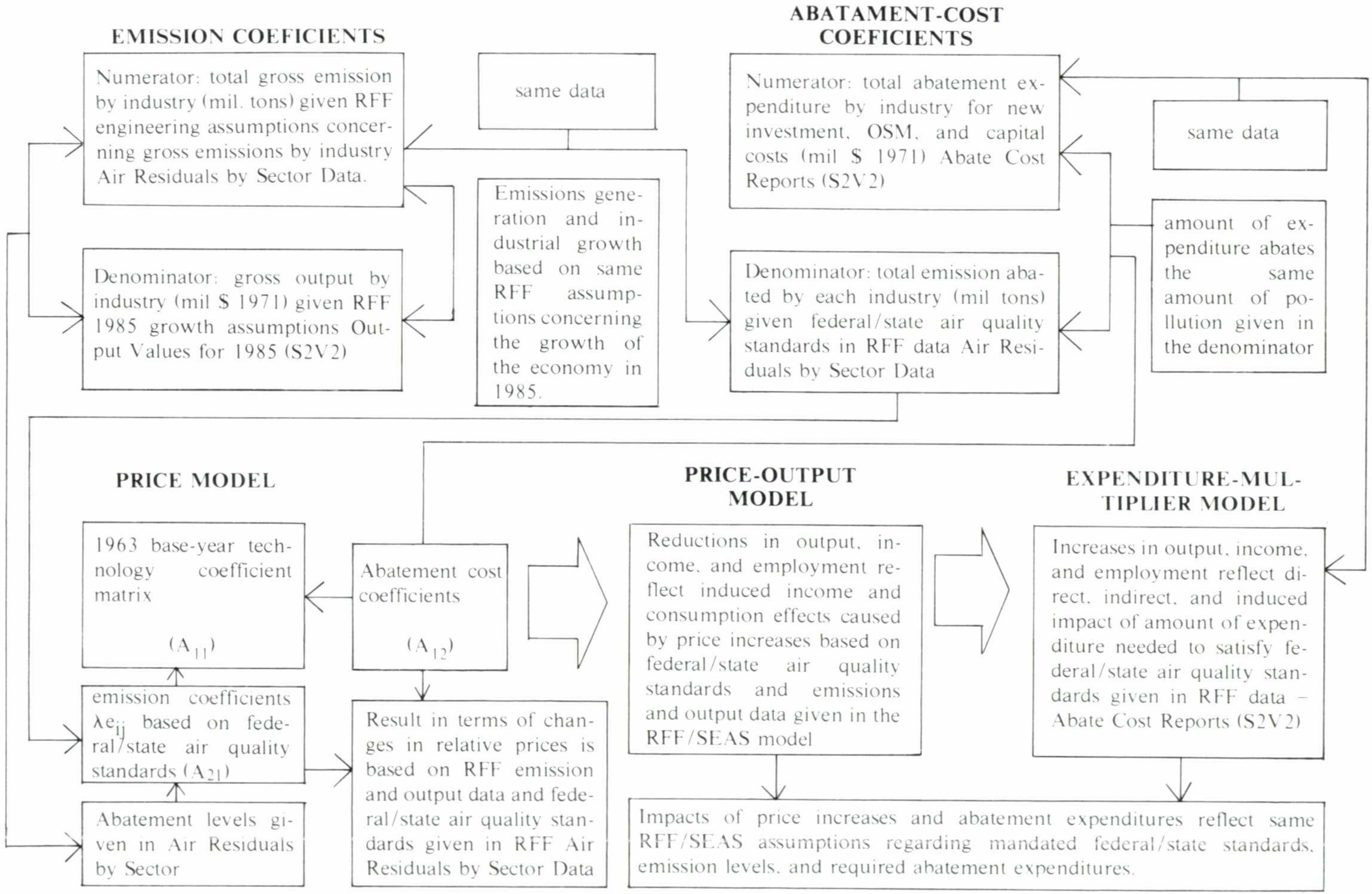


Figure 3. Illustration of overall solution procedures

1. PRICE MODEL

Exogenously determined emission and abatement-cost coefficients are incorporated into a multiregional Leontief interindustry framework. The model is solved through the dual price format in which additions to industry production functions result in shifts in the structure of relative prices.

$$\dot{p} = [I-(CA)^T]^{-1} u$$

where the Amatrix is modified by the emissions and abatement-cost coefficients, and λ's and the C matrix and O vector are from the 1963 MRIO data base.

2. PRICE-OUTPUT MODEL

The partially closed multiplier format is used where the technology matrix is closed with respect to households. Price effects enter through negative own-price elasticities coupled with price increases which reduce consumption and income in the system. The final results reflect reductions in output from direct, indirect, and induced effects of reduced houschold consumption of price-elastic polluter commodities.

$$X = (I-CA)^{-1} CY$$

where the A6 matrix is modified in the consumption and income coefficients. C and Y are from the MRIO data base.

3. ABATEMENT-EXPENDITURE MODEL

The partialy closed multiplier format is used where the technology matrix is closed with respect to households. Pollution abatement expenditures are allocated to regions and added to 1963 base-year final demands The output multiplier is then solved for the augmented final demands. The results reflect the direct, indirect, and induced output effects of pollution abatement expenditures.

$$X = (I-CA)^{-1} CY$$

where the Y vector of final demand is modified by the pollution abatement expenditures and the C and A matrices are given in the 1963 MRIO data base.

4. COMBINED PRICE-OUTPUT ABATEMENT-EXPENDITURE MODEL

Regional technology coefficient matrices adjusted for consumption and income effects from the shift in relative prices, from the price-output model, were combined with final demands augmented by pollution abatement expenditures from the abatement expenditure model. Results reflect the regional changes given both policy-based price effects and pollution abatement expenditures.

$$X = (I-CA)^{-1} CY$$

where the A matrix and Y vector are modified and the expanded trade flow matrix (C) is given in the 1963 MRIO data base.

5. TRADE-FLOW IMPACT MODEL

Trade flows are calculated for the 1963 base-year condition, and for the situation involving the pollution-policy-based price effect and pollution abatement expenditures. The two sets of trade-flow data are then compared for changes in total regional export, imports, and balances of trade, differences being expressed as percentages of the base year.

$$C_i \text{ cm } G_i^T = T_i$$

where the G vector represents total intermediate and final demand. Individual C matrices are given in the MRIO data base.

TABLE 1

NEW RELATIVE PRICES RESULTING FROM INCLUSION OF LAMBDAS, EMISSION COEFFICIENTS, AND ABATEMENT COST COEFFICIENTS

	1 NEW ENGLAND	2 MIDDLE ATLANTIC	3 EAST NORTH CENTRAL	4 WEST NORTH CENTRAL	5 SOUTH ATLANTIC	6 EAST SOUTH CENTRAL	7 WEST SOUTH CENTRAL	8 MOUNTAIN	9 PACIFIC	NATIONAL
1 LIVESTOCK, LIVESTOCK PRDT	1.010	1.011	1.015	1.014	1.012	1.011	1.012	1.015	1.014	1.014
2 OTHER AGRICULTURAL PRDTS	1.014	1.012	1.019	1.020	1.018	1.015	1.021	1.022	1.015	1.018
3 COAL MINING	1.017	1.040	1.035	1.022	1.036	1.036	1.026	1.034	1.028	1.034
4 CRUDE PETRO. NATURAL GAS	1.017	1.018	1.021	1.023	1.023	1.023	1.024	1.023	1.022	1.022
5 OTHER MINING	1.010	1.020	1.023	1.062	1.017	1.019	1.016	1.026	1.021	1.023
6 CONSTRUCTION	1.032	1.042	1.039	1.041	1.043	1.042	1.046	1.041	1.032	1.039
7 FOOD, TOBACCO, FAB. APPAREL.	1.015	1.012	1.015	1.014	1.013	1.013	1.014	1.014	1.015	1.014
8 TRANSPORT EQPT. ORDENANCE	1.028	1.034	1.039	1.036	1.035	1.033	1.031	1.027	1.030	1.034
9 LUMBER & PAPER	1.031	1.031	1.032	1.031	1.033	1.034	1.033	1.031	1.033	1.032
10 PETROLEUM, RELATED INDS.	1.209	1.221	1.225	1.224	1.220	1.225	1.223	1.222	1.222	1.222
11 PLASTICS & CHEMICALS	1.029	1.030	1.030	1.030	1.030	1.030	1.029	1.026	1.029	1.030
12 GLASS, STONE, CLAY PRDTS.	1.248	1.241	1.243	1.246	1.244	1.241	1.242	1.247	1.243	1.243
13 PRIMARY IRON, STEEL MFR.	1.165	1.168	1.170	1.165	1.165	1.167	1.156	1.169	1.163	1.167
14 PRIMARY NONFERROUS MFB	1.124	1.110	1.118	1.118	1.109	1.122	1.116	1.120	1.118	1.116
15 MACHINERY & EQUIPMENT	1.031	1.031	1.036	1.037	1.034	1.038	1.038	1.033	1.032	1.034
16 SERVICES	1.008	1.008	1.008	1.008	1.008	1.008	1.008	1.008	1.008	1.008
17 TRANSPORT. & WAREHOUSING	1.014	1.015	1.015	1.015	1.016	1.014	1.015	1.015	1.016	1.015
18 GAS & WATER SERVICES	1.008	1.009	1.008	1.009	1.008	1.008	1.008	1.009	1.007	1.003
19 ELECTRIC UTILITIES	1.191	1.190	1.191	1.190	1.191	1.189	1.191	1.189	1.187	1.190
20 POLLUTION ABATEMENT	0.399	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.399	0.400
ALL INDUSTRIES	1.030	1.032	1.038	1.031	1.031	1.032	1.036	1.032	1.032	

TABLE 2
PERCENT REDUCTION IN 1963 BASE YEAR REGIONAL OUTPUTS RESULTING FROM THE POLLUTION PRICE EFFECT

	1 NEW ENGLAND	2 MIDDLE ATLANTIC	3 EAST NORTH CENTRAL	4 WEST NORTH CENTRAL	5 SOUTH ATLANTIC	6 EAST SOUTH CENTRAL	7 WEST SOUTH CENTRAL	8 MOUNTAIN	9 PACIFIC	NATIONAL
1 LIVESTOCK, LIVESTOCK PRDT	ę2.58	ę2.50	ę2.42	ę2.24	ę2.44	ę2.29	ę2.22	ę2.20	ę2.30	ę2.33
2 OTHER AGRICULTURAL PRDTS	ę2.22	ę2.15	ę2.05	ę1.81	ę2.05	ę1.82	ę1.51	ę1.78	ę1.78	ę1.90
3 COAL MINING	ę3.14	ę2.15	ę2.30	ę2.93	ę2.17	ę2.27	ę2.99	ę2.37	ę2.36	ę2.34
4 CRUDE PETRO., NATURAL GAS	ę3.19	ę3.15	ę3.11	ę2.84	ę3.08	ę2.77	ę2.70	ę2.62	ę2.65	ę2.85
5 OTHER MINING	ę1.49	ę1.19	ę1.21	ę1.19	ę1.15	ę1.09	ę0.98	ę0.84	ę0.85	ę1.08
6 CONSTRUCTION	ę0.41	ę0.63	ę0.50	ę0.41	ę0.36	ę0.36	ę0.37	ę0.26	ę0.24	ę0.40
7 FOOD, TOBACCO, FAB. APPAREL	ę2.78	ę2.69	ę2.81	ę2.63	ę2.60	ę2.57	ę2U*43	ę2.52	ę2.67	ę2.66
8 TRANSPORT EQRT. ORDNANCE	ę0.99	ę1.05	ę1.01	ę1.00	ę1.09	ę1.05	ę1.01	ę1.94	ę0.87	ę1.00
9 LUMBER & PAPER	ę2.07	ę1.97	ę2.09	ę2.13	ę2.13	ę2.22	ę2.19	ę2.07	ę1.99	ę2.07
10 PETROLEUM, RELATED INDS.	ę3.62	ę3.39	ę3.31	ę2.98	ę3.30	ę3.12	ę2.76	ę2.78	ę2.83	ę3.12
11 PLASTICS & CHEMICALS	ę1.75	ę1.69	ę1.67	ę1.67	ę1.74	ę1.68	ę1.60	ę1.63	ę1.66	ę1.68
12 GLASS, STONE, CLAY PRDTS	ę2.45	ę2.32	ę2.13	ę2.16	ę1.99	ę2.06	ę1.83	ę1.83	ę1.84	ę0.08
13 PRIMARY IRON, STEEL MFR.	ę1.04	ę0.99	ę1.01	ę1.03	ę0.98	ę0.98	ę0.94	ę0.86	ę0.92	ę0.99
14 PRIMARY NONFERROUS MFR	ę0.94	ę0.94	ę0.97	ę0.95	ę0.94	ę0.94	ę0.90	ę0.86	ę0.84	ę0.93
15 MACHINERY & EQUIPMENT	ę1.18	ę1.19	ę1.24	ę1.26	ę1.26	ę1.31	ę1.37	ę1.22	ę1.17	ę1.23
16 SERVICES	ę2.36	ę2.37	ę2.39	ę2.19	ę2.19	ę2.16	ę2.13	ę2.02	ę2.15	ę2.26
17 TRANSPORT. & WAREHOUSING	ę1.87	ę1.76	ę1.68	ę1.66	ę1.70	ę1.68	ę1.58	ę1.60	ę1.62	ę1.64
18 GAS & WATER SERVICES	ę2.66	ę2.65	ę2.69	ę2.58	ę2.48	ę2.43	ę2.36	ę2.30	ę2.30	ę2.54
19 ELECTRIC UTILITIES	ę4.54	ę4.42	ę4.49	ę4.67	ę4.74	ę4.72	ę4.47	ę4.06	ę4.19	ę4.48
20 WAGES AND SALARIES	ę2.03	ę2.11	ę2.17	ę1.81	ę1.78	ę1.71	ę1.68	ę1.51	ę1.88	ę1.94
ALL INDUSTRIES	ę2.02	ę2.06	ę1.00	ę1.90	ę1.90	ę1.87	ę1.83	ę1.68	ę1.77	

TABLE 3

PERCENT INCREASE IN 1963 BASE REGIONAL OUTPUTS RESULTING FROM POLLUTION ABATEMENT EXPENDITURES

	1 NEW ENGLAND	2 MIDDLE ATLANTIC	3 EAST NORTH CENTRAL	4 WEST NORTH CENTRAL	5 SOUTH ATLANTIC	6 EAST SOUTH CENTRAL	7 WEST SOUTH CENTRAL	8 MOUNTAIN	9 PACIFIC	NATIONAL
1 LIVESTOCK, LIVESTOCK PRDT	2.80	2.66	2.58	2.31	2.56	2.37	2.25	2.15	2.08	2.39
2 OTHER AGRICULTURAL PRDTS	2.51	2.40	2.26	1.89	2.20	1.92	1.56	1.73	1.77	2.02
3 COAL MINING	6.67	4.93	5.26	6.43	4.81	5.09	6.90	4.67	4.54	5.24
4 CRUDE PETRO, NATURAL GAS	7.20	6.95	7.18	6.52	6.74	6.37	6.79	6.25	6.35	6.78
5 OTHER MINING	4.36	4.32	4.17	3.95	4.02	3.93	3.90	3.19	2.88	3.86
6 CONSTRUCTION	1.96	2.29	2.15	1.90	1.80	1.85	2.08	1.70	1.83	1.93
7 FOOD, TOBACCO, FAB. APPAREL	3.04	2.97	3.17	2.71	2.65	2.65	2.45	2.27	2.35	2.78
8 TRANSPORT EQPT. ORDNANCE	1.33	1.42	1.38	1.31	1.37	1.36	1.33	1.22	1.09	1.32
9 LUMBER AND PAPER	2.63	2.52	2.77	2.45	2.45	2.58	2.55	2.08	2.14	2.50
10 PETROLEUM, RELATED INDS.	8.12	7.97	8.10	7.38	7.52	7.53	7.57	7.22	7.12	7.07
11 PLASTICS & CHEMICALS	8.91	8.83	8.93	8.73	8.65	8.71	8.76	7.99	7.96	8.70
12 GLASS, STONE, CLAY PRDTS	5.33	5.18	5.10	4.71	4.55	4.64	4.62	4.22	4.26	4.80
13 PRIMARY IRON, STEEL MFR.	4.41	4.09	3.99	3.97	3.91	3.87	3.83	3.46	3.63	3.97
14 PRIMARY NONFERROUS MFR.	4.43	4.43	4.50	4.38	4.40	4.29	4.03	3.87	3.66	4.30
15 MACHINERY & EQUIPMENT	6.37	6.35	6.49	6.30	6.14	6.29	6.26	5.97	5.96	6.28
16 SERVICES	3.27	3.26	3.51	2.77	2.60	2.72	2.96	2.39	2.48	2.99
17 TRANSPORT. & WAREHOUSING	3.43	3.28	3.15	2.94	3.04	3.03	3.11	2.68	2.70	3.08
18 GAS & WATER SERVICES	4.45	4.55	4.72	4.02	3.95	4.22	4.60	3.52	3.30	4.25
19 ELECTRIC UTILITIES	10.09	10.09	10.32	9.32	9.35	9.44	9.88	9.02	8.97	9.74
20 WAGES AND SALARIES	3.18	3.23	3.53	2.48	2.35	2.45	2.53	2.02	2.34	2.85
ALL INDUSTRIES	3.65	3.71	3.86	3.08	3.10	3.19	3.43	2.93	2.84	

TABLE 4

NET PERCENT CHANGE IN 1963 BASE YEAR REGIONAL OUTPUTS RESULTING FROM THE POLLUTION PRICE EFFECT AND POLLUTION ABATEMENT EXPENDITURES

	1 NEW ENGLAND	2 MIDDLE ATLANTIC	3 EAST NORTH CENTRAL	4 WEST NORTH CENTRAL	5 SOUTH ATLANTIC	6 EAST SOUTH CENTRAL	7 WEST SOUTH CENTRAL	8 MOUNTAIN	9 PACIFIC	NATIONAL
1 LIVESTOCK, IVESTOCK PRDT	0.13	0.08	0.09	ę0.01	0.04	0.00	ę0.04	ę0.12	ę0.29	ę0.01
2 OTHER AGRICULTURAL PRDTS	0.21	0.18	0.14	0.03	0.09	0.04	0.01	ę0.10	ę0.06	0,06
3 COAL MINING	3.43	2.71	2.89	3.42	2.58	2.75	3.84	2.24	2.12	3.82
4 CRUDE PETRO., NATURAL GAS	3.90	3.70	3.97	3.60	3.56	3.52	4.01	3.56	3.64	3.84
5 OTHER MINING	2.83	3.09	2.92	2.72	2.83	2.80	2.89	2.32	2.01	2.74
6 CONSTRUCTION	1.53	1.65	1.63	1.48	1.43	1.47	1.65	1.43	1.39	1.52
7 FOOD, TOBACCO, FAB. APPAREL	0.17	0.19	0.27	ę0.01	ę0.03	ę0.00	ę0.04	ę0.32	ę0.39	0,04
8 TRANSPORT EQPT. ORDNANCE	0.31	0.33	0.33	0.28	0.25	0.28	0.28	0.25	0.20	0.29
9 LUMBER & PAPER	0.49	0.48	0.61	0.25	0.26	0.29	0.30	ę0.04	0.10	0,37
10 PETROLEUM, RELATED INDS.	4.38	4.47	4.68	4.31	4.13	4.32	4.73	4.36	4.22	4.45
11 PLASTICS & CHEMICALS	7.10	7.09	7.20	7.01	6.86	6.98	7.11	6.32	6.26	6.97
12 GLASS, STONE, CLAY PRDTS	2.80	2.70	2.90	2.49	2.51	2.53	2.74	2.35	2.37	2.66
13 PRIMARY IRON, STEEL MFR	3.34	3.06	2.94	2.91	2.90	2.86	2.86	2.58	2.68	2.94
14 PRIMARY NONFERROUS MFR	3.47	3.46	3.49	3.40	3.42	3.33	3.10	2.99	2.80	3.34
15 MACHINERY & EQUIPMENT	5.16	5.12	5.21	5.00	4.85	4.95	4.85	4.71	4.75	0.02
16 SERVICES	0.83	0.81	1.04	0.51	0.34	0.49	0.76	0.31	0.27	0.66
17 TRANSPORT & WAREHOUSING	1.50	1.46	1.42	1.23	1.28	1.30	1.48	1.03	1.03	1.33
18 GAS & WATER SERVICES	1.70	1.81	1.93	1.36	1.40	1.72	2.16	1.18	0.93	1.64
19 ELECTRIC UTILITIES	5.40	5.52	5.67	4.52	4.49	4.60	5.29	4.87	4.68	5.12
20 WAGES AND SALARIES	1.08	1.05	1.28	0.62	0.51	0.68	0.80	0.47	0.45	0.85
ALL INDUSTRIES	1.57	1.58	1.74	1.11	1.14	1.26	1.54	1.01	1.02	

List of references

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