UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 18 1983

MEMORANDUM

SUBJECT: Analysis of NHANES II Data to Determine The Relationship Between Gasoline Lead and Blood Lead

FROM: Joel Schwartz
Office of Policy Analysis Joel

TO: David Weil
ECAO

This paper discusses our attempts to quantify the relationship between gasoline lead and blood lead. That this relationship exists has been settled by the lead isotope experiment in Italy, which indicates that about 8ug/dl of blood lead is due to gasoline in the Turin area. We have attempted to use statistical techniques to investigate this relationship in the United States both because we needed such knowledge to assess the gasoline lead regulations (they were recently tightened), and to assess the approximate magnitude of the contribution of air lead emissions to blood lead via secondary pathways.

Preliminary assessments were made by regressing local SMSA gasoline lead usuage in Chicago, New York, and Louisville against the results of the lead screening program in those locations. While 450,000 children were screened in New York, 880,000 in Chicago, and over 10,000 in Louisville, these children were not a random sample of the population. Although the sampling rates of 20% per year for black preschool children indicates the bias is

N33870

TEH 0532080

not great, industry has objected to the drawing of any inferences from this data. Therefore, we began to analyze the NHANES II data as soon as a public tape became available.

Hypothesis Testing

Since we had evidence that gasoline lead is a major causal variable, we engaged in hypothesis testing to determine if inclusion of other factors could lead us to reject that hypothesis. NCHS had already published material suggesting what demographic data was significant. In addition, we gathered data from FDA on food lead, and discussed in the December 1982 ICF report our reasons for rejecting paint lead as a source of misspecification error. We used monthly lead in gasoline sales as an independent variable and individual blood lead as the dependent variable. It is important to note that since NHANES stands were usually in a given location during two months, this formulation allows us to look at variations in blood lead with time at a single site, as well as between sites.

We first examined a large model with all major demographic variables, some of their interactions among themselves, some of their interactions with gasoline lead, and gasoline. After eliminating some insignificant variables (eg. kid x gas, inside center city x gas, etc.), we arrived at the models 1 and 2 from our December report. In both models gasoline lead explained a large share of blood lead.

As we have noted before, it is important to realize that time is not a causal determinant of blood lead. Unlike processes such as aging, cardiovascular disease, etc., time has no direct relationship to blood lead through inherent entropic processes. Indeed, if we focus on the same age group over time, the only relationship between blood lead and time can be through a direct causal variable. The only known causal variable that decreased significantly over this four year period was gasoline lead. Therefore, time is included not as an explanatory variable, but as a further test to make sure gasoline lead had a strong enough relationship that it would remain significant even if time was a competing variable.

In Table 3 and 4, the insignificant variables are dropped. The gasoline lead coefficient is stable, and its significance increases. Table 4a is a similar run, but has only one month lagged gasoline. It is included to facilitate comparison with other runs we include in this paper that used only one gasoline variable to test hypotheses. Note that even after surregr accounts for the design effect, the F statistic on gasoline when only one gasoline coefficient is included is 116.1. Without including time, mean NHANES gasoline lead accounted for 57% of mean NHANES blood lead, or 8 ug/dl. With time included, gasoline lead still accounted for 43% of blood lead, or 6 ug/dl.

The Ethyl Corporation suggested that we test the individual cities where the sampling was performed to see if characteristics of these sites caused the down trend in blood lead, rather than gasoline. Table 5 shows the results with dummy variables for all the sites with population over 100,000, and one for the remaining

Natl Gas Pb = (monthly Gas Sales) & (Pb content)
Leaded

TABLE

RESULTS FROM SURREGR: WHITES

Hypothesis Testing Results
Model Number 1
Dependent Variable: Lead
32 Denominator Degrees of Freedom

Independent Effect	Coefficient	F Value	Degrees of Freedom	Probability
INTERCEPT	6.55			
TIME	-1.06	4.92	1	0.0337
TEEN	-.65	8.47	1	0.0065
TEENMALE	1.51	19.79	1	0.0001
KID	3.06	92.58	1	0.0000
ADLTMALE	4.34	177.66	1	0.0000
MALE	.67	5.17	1	0.0299
RURAL	-1.29	12.08	1	0.0015
SMALL	-.80	5.94	1	0.0205
INCOME1	1.14	14.89	1	0.0005
INCOME2	.54	13.15	1	0.0010
WINTER	-.18	0.13	1	0.7167
SPRING	-.44	1.64	1	0.2100
FALL	-.07	0.02	1	0.8765
NGASPB	.44	1.18	1	0.2850
NGASPB(-1)	1.36 .92	5.34	1	0.0274
TEST FOR OVERALL MODEL		101.36	15	0.0000

Model Number 2
Dependent Variable: Lead
32 Denominator Degrees of Freedom

Independent Effect	Coefficient	F Value	Degrees of Freedom	Probability
INTERCEPT	5.73			
TIME	-.88	4.40	1	0.0438
TEEN	-.64	8.29	1	0.0070
TEENMALE	1.52	18.69	1	0.0001
KID	3.07	94.28	1	0.0000
ADULTMALE	4.34	173.69	1	0.0000
MALE	.66	4.92	1	0.0338
RURAL	-1.30	11.56	1	0.0018
SMALL	-.85	6.52	1	0.0157
INCOME1	1.12	13.76	1	0.0008
INCOME2	.54	12.98	1	0.0011
NGASPB	.39	1.14	1	0.2941
NGASPB(-1)	1.12	7.22	1	0.0113
TEST FOR OVERALL MODEL	1.51	130.97	12	-0.0000

ICF Incorporated

TEH 0533083

DUP050034353

TABLE 5 (Continued)

Model Number 3
Dependent Variable: Lead
32 Denominator Degrees of Freedom

Independent Effect	Coefficient	F Value	Degrees of Freedom	Probability
INTERCEPT	5.74			
TIME	-.85	4.04	1	0.0530
TEEN	-.64	8.25	1	0.0072
TEENMALE	1.52	18.58	1	0.0001
KID	3.06	112.29	1	0.0000
KIDTIME	-.71	2.74	1	0.1076
ADLTMALE	4.35	176.94	1	0.0000
MALE	.66	5.02	1	0.0322
RURAL	-1.30	11.63	1	0.0018
SMALL	-.85	6.55	1	0.0154
INCOME1	1.12	13.69	1	0.0008
INCOME2	.54	12.96	1	0.0011
NGASPB	.39	1.13	1	0.2949
NGASPB(-1)	1.12	7.19	1	0.0115
TEST FOR OVERALL MODEL	1,51	128.82	13	0.0000

Model Number 4
Dependent Variable: Lead
32 Denominator Degrees of Freedom

Independent Effect	Coefficient	F Value	Degrees of Freedom	Probability
INTERCEPT	3.74			
TEEN	-.63	8.04	1	0.0079
TEENMALE	1.54	19.20	1	0.0001
KID	3.11	93.94	1	0.0000
ADLTMALE	4.35	169.23	1	0.0000
MALE	.66	4.74	1	0.0369
RURAL	-1.45	14.91	1	0.0005
SMALL	-1.00	7.74	1	0.0090
INCOME1	1.21	16.50	1	0.0003
INCOME2	.59	16.14	1	0.0003
NGASPB	.74	4.54	1	0.0410
NGASPB(-1)	1.25	9.17	1	0.0046
TEST FOR OVERAL MODEL	1,79	168.26	11	0.0000

Table 4A

0 32 DENOMINATOR DEGREES OF FREEDOM

0DEPENDENT EFFECT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
LEAD			
TEST FOR OVERALL MODEL	135.80	10	0.0000
0INDEPENDENT EFFECTS			
TEEN	7.82	1	0.0087
TEENMALE	16.25	1	0.0002
KID	93.63	1	0.0000
ADLTMALE	163.28	1	0.0000
MALE	4.75	1	0.0368
RURAL	15.13	1	0.0005
SMALL	7.13	1	0.0118
INCOME1	16.72	1	0.0002
INCOME2	17.14	1	0.0002
PB1	116.10	1	0.0000

1HYPOTHESIS TESTING RESULTS

1MODEL NUMBER 1

0BETA VALUES FOR DEPENDENT EFFECT

LEAD

INTERCPT	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	PB1
3.9205	-.621184	1.52837	3.11284	4.34751	0.672767	-1.44975	-.937930	1.20502	0.606638	1.93667

0GENERAL MEAN SQUARE ERRORS

0

INTERCPT	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	PB1
0.654342										
-.051428	.0496638									
-.118748	-.004614	0.127971								
-.109907	.0360938	.0611359	0.108487							
-.119018	.0140402	.0674308	.0510251	0.115758						
.0845779	-.005656	-.088925	-.035612	-.093796	.0952922					
-.069341	-.008796	.0150078	.0073856	.0036572	-.012098	0.17721				
-.026718	-.0232	.0129101	-.001578	.0234282	-.004133	0.094449	0.129371			
-0.01423	4.5E-04	0.006277	.0106179	.0123376	6.8E-04	.0348134	.0147229	.0912324		
-.005172	.0104262	4.3E-04	7.1E-04	.0035054	-.001758	-.011283	-.011678	.0034973	.021465	
-.175625	.0114449	.0204149	.0214767	.0181765	-.015525	-.012317	-.012082	-.004495	.0010598	.0523662

TEH 0533085

DUP050034355

SSE	3872474623	F RATIO	59.92
DFE	8543	PROB>F	0.0001
MSE	453292.1	R-SQUARE	0.2820

Whites, with city Dummies

DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>!T!
1	3.497781	0.452936	7.7225	0.0001
1	3.087018	0.357316	8.6395	0.0001
1	-0.669035	0.188388	-3.5514	0.0004
1	1.454332	0.535378	2.7165	0.0066
1	4.270143	0.498467	8.5666	0.0001
1	-0.585855	0.139134	-4.2107	0.0001
1	0.716765	0.482489	1.4856	0.1374
1	1.270794	0.174942	7.2641	0.0001
1	0.679544	0.116256	5.8451	0.0001
1	1.825827	0.104924	17.4014	0.0001
1	-1.601778	0.377478	-4.2434	0.0001
1	-0.156853	0.510992	-0.3070	0.7589
1	-0.510507	0.479102	-1.0656	0.2867
1	2.756296	0.468005	5.8895	0.0001
1	2.369888	0.485399	4.8824	0.0001
1	-0.046137	0.479736	-0.0962	0.9234
1	-1.421702	0.466453	-3.0479	0.0023
1	-0.846575	0.488808	-1.7319	0.0833
1	-0.391943	0.448189	-0.8745	0.3819
1	-1.114003	0.456987	-2.4377	0.0148
1	0.474797	0.350447	1.3548	0.1755
1	-0.799606	0.437764	-1.8266	0.0678
1	1.249359	0.448538	2.7854	0.0054
1	0.173703	0.515417	0.3370	0.7361
1	-1.320251	0.454004	-2.9080	0.0036
1	1.286737	0.475574	2.7057	0.0068
1	1.111488	0.402866	2.7589	0.0058
1	-2.285575	0.425742	-5.3684	0.0001
1	1.385128	0.436417	3.1739	0.0015
1	-0.498153	0.396487	-1.2564	0.2090
1	-0.197637	0.483996	-0.4083	0.6830
1	0.941245	0.417571	2.2541	0.0242
1	0.579861	0.564443	1.0273	0.3043
1	-1.212687	0.553122	-2.1924	0.0284
1	3.715863	0.450768	8.2434	0.0001
1	3.085999	0.560899	5.5019	0.0001
1	0.520680	0.486801	1.0696	0.2848
1	1.478956	0.488766	3.0383	0.0024
1	0.577997	0.506578	1.1410	0.2539
1	0.991668	0.430572	2.3031	0.0213
1	0.691660	0.488606	1.4156	0.1569
1	-0.885692	0.434387	-2.0389	0.0415
1	-0.256095	0.435258	-0.5884	0.5563
1	-0.503421	0.439511	-1.1454	0.2521
1	0.819735	0.427724	1.9165	0.0553
1	0.932059	0.518510	1.7976	0.0723
1	-0.652441	0.497691	-1.3109	0.1899
1	2.665472	0.456551	5.8383	0.0001
1	0.082495	0.467020	0.1766	0.8598
1	0.432105	0.892022	0.4844	0.6281
1	2.571917	0.417332	6.1628	0.0001
1	-0.970167	0.413336	-2.3469	0.0190
1	-0.125262	0.491646	-0.2548	0.7989
1	0.505905	0.449511	1.1255	0.2604
1	0.722573	0.378829	1.9074	0.0565
1	-1.253702	0.443310	-2.8280	0.0047

Mean Blood Lead Explained by Gasoline = 7.30 ug/dl

y
dual
nt
of
r-
31
ıphic
ing,
lly
as
st
be

TEH 0533086

DUP050034356

MODEL: MODEL01		SSE	3875742624	F RATIO	59.74
WEIGHT: WEIGHT		DFE	8543	PROB>F	0.0001
DEP VAR: LEAD		MSE	453674.7	R-SQUARE	0.2814

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>:T:
INTERCEPT	1	3.566139	0.450296	7.9195	0.0001
KID	1	3.087335	0.357438	8.6374	0.0001
TEEN	1	-0.670635	0.188478	-3.5582	0.0004
TEENMALE	1	1.459924	0.535568	2.7258	0.0064
ADLTMALE	1	4.273781	0.498674	8.5703	0.0001
RURAL	1	-0.626727	0.139019	-4.5082	0.0001
MALE	1	0.715666	0.482690	1.4827	0.1382
INCOME1	1	1.254777	0.174989	7.1706	0.0001
INCOME2	1	0.673179	0.116286	5.7890	0.0001
PBNAT1	1	1.825911	0.105147	17.3653	0.0001
GCITY2	1	-0.00437672	0.0009907555	-4.4176	0.0001
GCITY3	1	-0.00054402	0.001273909	-0.4270	0.6694
GCITY4	1	-0.00114548	0.0009497383	-1.2061	0.2278
GCITY5	1	0.005164469	0.0009456107	5.4615	0.0001
GCITY6	1	0.004474451	0.0009501301	4.7093	0.0001
GCITY7	1	-0.000286966	0.001246923	-0.2301	0.8180
GCITY8	1	-0.00386706	0.001218957	-3.1724	0.0015
GCITY9	1	-0.00172173	0.0009251465	-1.8610	0.0628
GCITY10	1	-0.000984606	0.0009570653	-1.0288	0.3036
GCITY11	1	-0.00262243	0.000974829	-2.6901	0.0072
GCITY12	1	0.0009818827	0.0007557867	1.2992	0.1939
GCITY13	1	-0.00169102	0.0008631215	-1.9592	0.0501
GCITY15	1	0.002953844	0.001164361	2.5369	0.0112
GCITY16	1	0.0002847331	0.001341235	0.2123	0.8319
GCITY17	1	-0.0033675	0.00111651	-3.0161	0.0026
GCITY18	1	0.002812646	0.001277136	2.2023	0.0277
GCITY19	1	0.00271887	0.001076825	2.5249	0.0116
GCITY20	1	-0.00583411	0.001062012	-5.4934	0.0001
GCITY21	1	0.003075677	0.001018465	3.0199	0.0025
GCITY22	1	-0.00108302	0.0007654441	-1.4149	0.1571
GCITY23	1	-0.000489823	0.0009218497	-0.5313	0.5952
GCITY24	1	0.001798618	0.0008434144	2.1325	0.0330
GCITY25	1	0.0008504229	0.00123065	0.6910	0.4896
GCITY26	1	-0.00289392	0.001246198	-2.3222	0.0202
GCITY27	1	0.007583897	0.0009433331	8.0395	0.0001
GCITY28	1	0.006811544	0.001259608	5.4077	0.0001
GCITY29	1	0.0009576675	0.001030911	0.9290	0.3529
GCITY30	1	0.003225387	0.001108298	2.9102	0.0036
GCITY31	1	0.000974132	0.0009788856	0.9951	0.3197
GCITY32	1	0.002249129	0.00103011	2.1834	0.0290
GCITY33	1	0.001174707	0.001062621	1.1055	0.2690
GCITY34	1	-0.00188936	0.0008765461	-2.1555	0.0312
GCITY35	1	-0.00072278	0.0009842864	-0.7343	0.4628
GCITY36	1	-0.00258761	0.002016557	-1.2832	0.1995
GCITY37	1	0.002259229	0.001265841	1.7850	0.0743
GCITY38	1	0.002032239	0.001217475	1.6692	0.0951
GCITY39	1	-0.0016364	0.001039576	-1.5633	0.1168
GCITY40	1	0.004985593	0.0008749449	5.6982	0.0001
GCITY41	1	.00007215277	0.001117145	0.0646	0.9485
GCITY42	1	0.001523407	0.003762857	0.4049	0.6856
GCITY43	1	0.006033215	0.001010315	5.9716	0.0001
GCITY44	1	-0.002656	0.001075392	-2.4698	0.0135
GCITY45	1	-0.000359673	0.001139936	-0.3155	0.7524
GCITY46	1	0.00116891	0.001062823	1.0998	0.2714
GCITY47	1	0.001857821	0.001061702	1.7499	0.0802
GCITY48	1	-0.00340895	0.001173408	-2.9052	0.0037
GCITY49	1	0.003267762	0.001187023	2.7529	0.0059

Whites, with city by gas interactions

Mean Blood Lead Explained by Gasoline = 7.30 ug/dl

TEH 0533087

DUP050034357

Since the current month's gasoline lead would have on average only 15 days to effect blood lead levels, one would expect it, to have a significant contribution, but a smaller one. By contrast, the previous month's gasoline lead represents emissions an average 15-45 days prior to examination. We would expect this to be more significant, with a noticeably higher coefficient. One would expect gasoline sold, on average 45-75 days previously (i.e. two month lagged gasoline) to be less significant and of lower magnitude than current month gasoline. By contrast, if gasoline sales were merely a proxy for time, all three months should be about equally good, since t, t-1, and t-2 (where t is the month since commencing the survey) equally represent the passage of time.

In fact, the results shown on Table 7 agree with our intuition based on the physical mechanisms. It does not appear to be consistent with the view that the gasoline coefficient is mostly due to some inexplicable time trend.

Our use of the Department of Energy's monthly sales data for leaded and unleaded gasoline allows us to examine this lag structure. The predominant cause of monthly changes in gasoline lead emissions is changes in sales volume. Our data captures both this effect and changes in the leaded-unleaded mix. The only factor that we do not have monthly is the lead content of gasoline, which refiners report quarterly.

As Table 8 indicates, however, this changed little over most of the period. Thus our gasoline variable does represent, as best as possible, the current month's emissions of gasoline lead,

Whites - Unconstrained Lag Structure without Time

1MODEL NUMBER 4
0BETA VALUES FOR DEPENDENT EFFECT

LEAD

INTERCPT	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	PBWAT	PB1	PB2
3.29218	-.634639	1.531	3.09296	4.35144	0.668183	-1.39423	-.909059	1.21175	0.566375	0.768547	0.874477	0.440603

1HYPOTHESIS TESTING RESULTS
0MODEL NUMBER 4
0 32 DENOMINATOR DEGREES OF FREEDOM

0DEPENDENT EFFECT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
LEAD			
TEST FOR OVERALL MODEL	157.09	12	0.0000
0INDEPENDENT EFFECTS			
TEEN	8.10	1	0.0077
TEENMALE	19.17	1	0.0001
KID	91.83	1	0.0000
ADLTMALE	167.81	1	0.0000
MALE	4.76	1	0.0365
RURAL	13.94	1	0.0007
SMALL	6.60	1	0.0150
INCOME1	16.63	1	0.0003
INCOME2	15.96	1	0.0004
PBWAT	4.94	1	0.0334
PB1	4.78	1	0.0362
PB2	2.04	1	0.1634

Mean Blood Lead Explained By Gasoline = 8.33 ug/dl

Whites - Unconstrained lag structure with Time

1MODEL NUMBER 3
0BETA VALUES FOR DEPENDENT EFFECT

LEAD

INTERCPT	TIME	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	PBNAT	FB1	FB2
5.31846	-.848538	-.644657	1.51085	3.06046	4.34317	0.665563	-1.26267	-.785147	1.12479	0.538707	0.423638	0.848557	0.322934

1HYPOTHESIS TESTING RESULTS
0MODEL NUMBER 3
0 32 DENOMINATOR DEGREES OF FREEDOM

0DEPENDENT EFFECT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
LEAD			
TEST FOR OVERALL MODEL	119.59	13	0.0000
0INDEPENDENT EFFECTS			
TIME	4.10	1	0.0514
TEEN	8.31	1	0.0070
TEENMALE	18.75	1	0.0001
KID	93.05	1	0.0000
ADLTMALE	172.33	1	0.0000
MALE	4.92	1	0.0337
RURAL	11.22	1	0.0021
SMALL	5.63	1	0.0239
INCOME1	13.95	1	0.0007
INCOME2	12.85	1	0.0011
PBNAT	1.39	1	0.2463
FB1	4.81	1	0.0356
FB2	1.07	1	0.3090

Mean Blood Lead explained by Gasoline = 6.38 ug/dl

TEH 0533090

DUP050034360

taking into account the "pipeline" effect mentioned by Dupont. To the extent that the use of quarterly grams per gallon distorts the data, it should tend to obscure the lag structure. The fact that the lag structure remains apparent even when noise is injected into the explanatory variable is reassuring.

This examination of the lag structure and our understanding of the residence time of lead in the blood suggests that a distributed lag best explains the relationship between gasoline lead and blood lead. We have chosen a distributed lag model in which the current month's gasoline lead variable has an unconstrained estimated coefficient. A weighted average lagged gasoline lead variable was created using the weighting PBLAG = .571PB1 + .286PB2 + .143PB3 where the weights go down by one half each month and sum to unity to allow comparison with other gasoline lead estimated coefficients. Decay rates other than 1/2 could have been chosen, but 1/2 was used because (as mentioned above) the half-life of lead in the blood could be about one month, and because when we tested 3 free gasoline lead coefficients PB2 was approximately 1/2 of PB1. The results of using this lagged gasoline exposure variable are shown in tables 10 and 11. Once again gasoline lead is very significant, and accounts for 60 % of blood lead, or 8.46 ug/dl.

Subgroup Analysis

In addition to our attempts to control for changes in demographic subgroup representation during the NHANES period by using dummy variables and interaction terms, we have also done separate

Table 8

Year	Grams Per Leaded Gallon
1976 I Quarter	2.01
1976 II Quarter	2.18
1976 III Quarter	2.22
1976 IV Quarter	1.92
1977 I Quarter	1.92
1977 II Quarter	2.17
1977 III Quarter	2.23
1977 IV Quarter	1.91
1978 I Quarter	1.72
1978 II Quarter	1.96
1978 III Quarter	2.24
1978 IV Quarter	2.09
1979 I Quarter	2.07
1979 II Quarter	2.08
1979 III Quarter	2.23
1979 IV Quarter	1.40
1980 I Quarter	1.33

Whites - Distributed Lag without time

1MODEL NUMBER 2
0BETA VALUES FOR DEPENDENT EFFECT

LEAD

INTERCPT	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	WINTER	SPRING	FALL	GASLAG	PBNAT
2.49284	-0.63553	1.4972	3.05422	4.33234	0.680992	-1.34423	-.861703	1.16971	0.573274	0.385193	0.168108	-.099651	1.44537	0.798757

Mean Blood Lead Explained by Gasoline = 8.97 ug/dl

1MODEL NUMBER 4
0BETA VALUES FOR DEPENDENT EFFECT

LEAD

INTERCPT	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	GASLAG	PBNAT
3.15621	-.655701	1.52914	3.08863	4.35609	0.664848	-1.39565	-.900924	1.20722	0.564708	1.25494	0.859632

Mean Blood Lead Explained By Gasoline = 8.46 ug/dl

TEH 0533093

DUP050034363

0MODEL NUMBER 2
0 32 DENOMINATOR DEGREES OF FREEDOM

0DEPENDENT EFFECT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
LEAD			
TEST FOR OVERALL MODEL	111.69	14	0.0000
0INDEPENDENT EFFECTS			
TEEN	8.21	1	0.0073
TEENMALE	19.46	1	0.0001
KID	92.03	1	0.0000
ADLTMALE	171.60	1	0.0000
MALE	5.15	1	0.0302
RURAL	11.92	1	0.0016
SMALL	6.13	1	0.0188
INCOME1	16.69	1	0.0003
INCOME2	15.73	1	0.0004
WINTER	0.82	1	0.3714
SPRING	0.18	1	0.6705
FALL	0.04	1	0.8360
GASLAG	6.41	1	0.0164
PBNAT	3.35	1	0.0765

1HYPOTHESIS TESTING RESULTS
0MODEL NUMBER 4
0 32 DENOMINATOR DEGREES OF FREEDOM

0DEPENDENT EFFECT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
LEAD			
TEST FOR OVERALL MODEL	156.31	11	0.0000
0INDEPENDENT EFFECTS			
TEEN	8.14	1	0.0075
TEENMALE	19.49	1	0.0001
KID	92.69	1	0.0000
ADLTMALE	168.67	1	0.0000
MALE	4.76	1	0.0367
RURAL	13.79	1	0.0008
SMALL	6.19	1	0.0183
INCOME1	16.62	1	0.0003
INCOME2	16.13	1	0.0003
GASLAG	8.36	1	0.0068
PBNAT	7.05	1	0.0123

Whites- Distributed Lag with Time

1MODEL NUMBER 1
0BETA VALUES FOR DEPENDENT EFFECT

LEAD

INTERCPT	TIME	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	WINTER	SPRING	FALL
6.00706	-.987376	-.650938	1.51012	3.04676	4.3439	0.670203	-1.27173	-.772378	1.1352	0.537423	-.214954	-.354305	-0.19857

GASLAG	PBNAT
0.963971	0.513474

Mean Blood Lead Explained By Gasoline = 5.90 ug/dl

1MODEL NUMBER 3
0BETA VALUES FOR DEPENDENT EFFECT

LEAD

INTERCPT	TIME	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	GASLAG	PBNAT
5.13561	-.828299	-.645225	1.50917	3.05606	4.3477	0.66256	-1.26466	-0.77495	1.12132	0.537476	1.08426	0.550044

Mean Blood Lead Explained by Gasoline = 6.55 ug/dl

TEH 0533095

DUP050034365

1HYPOTHESIS TESTING RESULTS
0MODEL NUMBER 1
0 32 DENOMINATOR DEGREES OF FREEDOM

DEPENDENT EFFECT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
LEAD			
TEST FOR OVERALL MODEL	96.29	15	0.0000
0INDEPENDENT EFFECTS			
TIME	4.44	1	0.0430
TEEN	8.46	1	0.0066
TEENMALE	20.30	1	0.0001
KID	92.27	1	0.0000
ADLTMALE	177.87	1	0.0000
MALE	5.18	1	0.0297
RURAL	11.32	1	0.0020
SMALL	5.47	1	0.0257
INCOME1	14.61	1	0.0006
INCOME2	13.18	1	0.0010
WINTER	0.18	1	0.6726
SPRING	0.84	1	0.3656
FALL	0.17	1	0.6796
GASLAG	3.15	1	0.0855
PBNAT	1.17	1	0.2882

1HYPOTHESIS TESTING RESULTS

1HYPOTHESIS TESTING RESULTS
0MODEL NUMBER 3
0 32 DENOMINATOR DEGREES OF FREEDOM

DEPENDENT EFFECT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
LEAD			
TEST FOR OVERALL MODEL	124.91	12	0.0000
0INDEPENDENT EFFECTS			
TIME	3.83	1	0.0592
TEEN	8.32	1	0.0070
TEENMALE	19.06	1	0.0001
KID	93.28	1	0.0000
ADLTMALE	173.11	1	0.0000
MALE	4.91	1	0.0339
RURAL	11.07	1	0.0022
SMALL	5.33	1	0.0276
INCOME1	13.91	1	0.0007
INCOME2	12.94	1	0.0011
GASLAG	6.06	1	0.0194
PBNAT	2.38	1	0.1327

regression analyses on several subgroups. The December 1982 ICF report contains separate runs for blacks and whites. In addition, Table 12 shows the results for urban groupings. Table 13 shows the regression results for males. Tables 14 shows the results for children.

Running separate regressions for children and adults should avoid any bias due to changes in the number of children. Similarly, changes in urban representation and black representation will not bias the results. These are major groups about whose representation the Ethyl Corporation expressed concern. All of these show strong, similar relationships between gasoline lead and blood lead. These results are presented using SURREGR, so the estimated F statistics take account of the survey design effect. The stability of the gasoline lead coefficient in all of these regressions suggests a relationship that is large and strong enough to shine through any difficulties introduced by the NHANES survey. It specifically addresses Ethyl's concern that the changing proportion of children and urban residents biased the results. Dr. Pirkle of CDC performed similar analyses using quarterly gasoline lead data (gas 1) and two different 6 monthly gas lead variables (gas 2 and gas 3). These results, in slightly different units, are included in Appendix II. They should ease Dr. Bradley's concern about controlling for subgroups as well. All of these regressions were run in SURREGR. In addition Appendix K of Dr. Pirkle's report to you shows similar regressions with time

RESULTS FROM SURREGR: URBAN

DEPENDENT VARIABLE: LEAD
32 DENOMINATOR DEGREES OF FREEDOM

INDEPENDENT VARIABLE	COEFFICIENT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
INTERCEPT	3.9558			
TEEN	-.6815	8.63	1	0.0061
TEENMALE	1.8243	10.89	1	0.0024
KID	4.3863	144.04	1	0.0000
ADLTMALE	4.2598	80.41	1	0.0000
MALE	.67699	2.40	1	0.1312
BLACK	1.5389	19.90	1	0.0001
INCOME1	1.33277	11.04	1	0.0022
INCOME2	.70786	20.68	1	0.0001
PBNAT1	1.8227	43.39	1	0.0000
TEST FOR OVERALL MODEL		204.08	9	0.0000

MEAN BLOOD LEAD EXPLAINED BY GASOLINE = 7.29 ug/dl

TEH 0533098

DUP050034368

RESULTS FROM SURREGR: MALE

DEPENDENT VARIABLE: LEAD
32 DENOMINATOR DEGREES OF FREEDOM

INDEPENDENT VARIABLE	COEFFICIENT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
INTERCEPT	7.8467			
TEEN	-3.481	166.95	1	0.0000
KID	-.9077	7.14	1	0.0118
BLACK	2.3801	36.72	1	0.0000
RURAL	-1.054	7.92	1	0.0083
SMALL	-.6587	3.99	1	0.0545
INCOME1	1.8029	15.59	1	0.0004
INCOME2	.96625	24.24	1	0.0000
PBNAT1	2.0888	113.49	1	0.0000
TEST FOR OVERALL MODEL		186.97	8	0.0000

MEAN BLOOD LEAD EXPLAINED BY GASOLINE = 8.35 ug/dl

TEH 0533099

DUP050034369

RESULTS FROM SURREGR: CHILDREN

DEPENDENT VARIABLE: LEAD
32 DENOMINATOR DEGREES OF FREEDOM

INDEPENDENT VARIABLE	COEFFICIENT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
INTERCEPT	6.2484			
MALE	.57282	2.96	1	0.0949
BLACK	3.8099	36.35	1	0.0000
RURAL	-2.378	8.93	1	0.0054
SMALL	-.9318	1.19	1	0.2832
INCOME1	3.6793	34.57	1	0.0000
INCOME2	1.2662	16.45	1	0.0003
PBNAT1	1.8813	19.30	1	0.0001
TEST FOR OVERALL MODEL		40.83	7	0.0000

MEAN BLOOD LEAD EXPLAINED BY G SOLINE = 7.52 ug/dl

TEH 0533100

DUP050034370

as well as gasoline lead. Gasoline lead is still highly significant in these runs they are in Appendix III to the back of this paper.

One or Two Stage Regression

One major issue the panel faces in comparing our analysis with Ethyl's is the question of whether a one stage or a two stage regression is appropriate. As Dr. Draper has pointed out, when the first stage and second stage variables are orthogonal, the results will be the same. Since in this case the first and second stage variables are clearly not orthogonal the question of which approach to follow remains. A two stage regression procedure biases against significance in the second stage variables by over attributing variance to their collinear first stage variables. For this reason we have adopted a single stage multiple regression approach. Dr. Bradley indicates that he would have performed a single stage regression, and the use of main effects and interaction terms, which is what we used in our analysis. Both Drs. Draper and Bradley remark that they would have preferred that the gasoline lead variable be regressed against the individual residuals for the 10,000 people (as in our one-stage and two-stage regressions) rather than against 55 site average residuals as Ethyl used. The reduction of a 10,000 person sample to 55 data points significantly limits the analysis.

We find several other difficulties with Ethyl's regression. The most important is their failure to use gasoline lead as a variable in the second stage. Instead, they use population density and annual state-wide gasoline lead divided by the area of the state. While in a world with constant gasoline usuage population density may be a partial proxy for gasoline lead, one would be hard put to find cities where the 50% reduction in gasoline lead usuage over 1976-80 was matched by a 50% drop in population density. This variable is inherently incapable of picking up either changes in unleaded gasoline share (18% to 47% over the period), or the regulatory induced drop in the concentration of lead in leaded gasoline (2.01 g/gal to 1.33 g/gal) over the period. As for annual gasoline lead per state divided by its area, the diversity in the size of states makes this a poor proxy as well. The areas of Arizona and Rhode Island do not adequately represent the relative exposure in Tuscon and Providence. Moreover, by using annual state lead emissions the Ethyl analysis automatically precludes an analysis relating monthly or seasonal changes in gasoline lead emissions to monthly or seasonal changes in blood lead, predudes any ability of gasoline lead to explain differences in blood lead between two sampling sites in the same state during the same year, and generally deadens the sensitivity of the analysis. Again, since the Ethly analysis also collapsed the residuals into a single value for each site, they eliminated the possibility of explaining month to month blood lead variation at a single site. Moreover, the Ethyl Corporation's analysis only controls for age, race, sex, and income plus city identifiers.

Our models also control for degree of urbanization, and center city or suburban residence in an SMSA. Finally, Ethyl does not indicate which of their 99 variables are insignificant. Based on our analysis of interaction terms and city dummies, many of the 99 variables they used in their first stage are insignificant. Leaving them in the first stage anyway downwardly biases the estimated coefficients in the second stage.

To test our reasoning that these variables were inapt, we performed a similar two stage regression. In the first stage we used the dummy variables previously shown to be significant, and the 49 site identifiers. This is almost exactly the approach of Ethyl's first stage. We then regressed gasoline lead against the residuals in the second stage, using monthly national gasoline lead as our independent variable as before. The result is shown in Table 18.

Even in the second stage regressions, gasoline lead has a t statistic of 13.4. The bias inherent in this two stage approach is illustrated in Table 19, where gasoline lead is in the first stage and the city variables in the second stage. Thus even the 2 stage approach, which can most accurately be viewed as a worst case torture test for the explanatory variable, demonstrates the strong relationship between gasoline lead and blood lead. We believe that the single stage multiple regression is the best approach to quantify that relationship.

Bias Due to Subgroup Definitions

Dr. Smith at the last meeting suggested that he knows how one can manipulate analyses by choice of dummy variables to produce

WHITE

MODEL: MODEL01 Table 18 SSE 218841.2 F RATIO 46.46 gas(-1)

DFE 8543 PROB>F 0.0001

DEP VAR: LEAD MSE 25.616430 R-SQUARE 0.2335

regress against resid

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>|T|	VARIABLE LABEL
INTERCEPT	1	10.990712	0.418790	26.2440	0.0001	
TEEN	1	0.133200	0.189996	0.7011	0.4833	
KID	1	3.028241	0.178570	16.9583	0.0001	
MALE	1	1.107513	0.174235	6.3564	0.0001	
ADLTMALE	1	3.684662	0.224692	16.3997	0.0001	
RURAL	1	-1.216269	0.395528	-3.0751	0.0021	
SMALL	1	-0.595116	0.405205	-1.4687	0.1420	
INCOME1	1	1.928799	0.166973	11.5516	0.0001	
INCOME2	1	0.964882	0.121658	7.9311	0.0001	
CITY2	1	-1.694539	0.468929	-3.6136	0.0003	
CITY3	1	-0.230628	0.711087	-0.3246	0.7455	
CITY4	1	1.357223	0.651931	2.0818	0.0374	
CITY5	1	4.139900	0.596357	6.9420	0.0001	
CITY6	1	4.708370	0.672504	7.0012	0.0001	
CITY7	1	0.296180	0.482012	0.6145	0.5389	
CITY8	1	-1.267992	0.491364	-2.5806	0.0099	
CITY9	1	2.187743	0.522244	4.1891	0.0001	
CITY10	1	1.028046	0.566063	1.8161	0.0694	
CITY11	1	0.124333	0.436524	0.2848	0.7758	
CITY12	1	2.629403	0.346419	7.5902	0.0001	
CITY13	1	1.776643	0.438406	4.0525	0.0001	
CITY14	1	2.924377	0.469305	6.2313	0.0001	
CITY15	1	0.279252	0.619416	0.4510	0.6520	
CITY16	1	0.244772	0.518651	0.4719	0.6370	
CITY17	1	-0.666620	0.440047	-1.5149	0.1298	
CITY18	1	-0.044464	0.649670	-0.0682	0.9442	
CITY19	1	1.812647	0.565958	3.2151	0.0013	
CITY20	1	-2.168170	0.442766	[illegible]	0.0001	
CITY21	1	1.564290	0.637203	2.4549	0.0141	
CITY22	1	0.407267	0.540933	0.7529	0.4515	
CITY23	1	1.507188	0.592316	[illegible]	[illegible]	
CITY24	1	3.255955	0.397692	8.1867	0.0001	
CITY25	1	1.276242	0.674382	1.8925	0.0585	
CITY26	1	-0.636652	0.689419	-0.9235	0.3558	
CITY27	1	4.693379	0.642025	7.3103	0.0001	
CITY28	1	3.244964	0.743711	4.3632	0.0001	
CITY29	1	1.245291	0.691066	1.8021	0.0716	
CITY30	1	3.008525	0.514426	5.8483	0.0001	
CITY31	[illegible]	[illegible]				

TEH 0533104

DUP050034374

[illegible]		[illegible]	0.614240	1.7933	0.0730
CITY33	1	1.376348	0.629839	2.1852	0.0289
CITY34	1	1.431562	0.421611	3.3955	0.0007
CITY35	1	0.844821	0.434146	1.9459	0.0517
CITY36	1	-3.697516	0.430454	-8.5902	0.0001
CITY37	1	-0.043473	0.569624	-0.0763	0.9392
CITY38	1	1.886794	0.696645	2.7084	0.0068
CITY39	1	2.167072	0.583421	3.7144	0.0002
CITY40	1	5.186691	0.48[illegible]	10.6373	0.0001

1 S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:31 FRIDAY, MARCH 4, 1983 2

0 .

0

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>|T|	VARIABLE LABEL
CITY41	1	0.870929	0.527944	1.6496	0.0991	
CITY42	1	-3.105837	1.055232	-2.9433	0.0032	
CITY43	1	2.498313	0.465705	5.3645	0.0001	
CITY44	1	-1.047466	0.389705	-2.6878	0.0072	
CITY45	1	0.783127	0.462579	1.6930	0.0905	
CITY46	1	1.473239	0.509587	2.8967	0.0038	
CITY47	1	0.525258	0.390950	1.3435	0.1791	
CITY48	1	-1.512086	0.369985	-3.2833	0.0001	
CITY49	1	1.469105	0.447466	3.2828	0.0010	

1 S T A T I S T I C A L A N A L Y S I S S Y S T E M 12:31 FRIDAY, MARCH 4, 1983 3

0

MODEL:	MODEL01	SSE	214331.7	F RATIO	180.90
		DFE	8598	PROB>F	0.0001
DEP VAR:	ALERT RESIDUALS	MSE	24.928037	R-SQUARE	0.0206

0

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>|T|	VARIABLE LABEL
INTERCEPT	1	-4.114912	0.310645	-13.2463	0.0001	
PRIMAT1	1	0.971564	0.072222	13.4499	0.0001	

COMMENT17

TEH 0533105

DUP050034375

WHITE Table 19

49 dummies regressed against residual.

MODEL: MODEL01

DEP VAR: LEAD

SSE	220734.6	F RATIO	286.11
DFE	8590	PROB>F	0.0001
MSE	25.696698	R-SQUARE	0.2269

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>|T|	VARIABLE LABEL
INTERCEPT	1	3.627719	0.361470	10.5893	0.0001	
TEEN	1	0.136862	0.189558	0.7220	0.4703	
KID	1	2.986502	0.177073	16.8659	0.0001	
MALE	1	1.162441	0.174068	6.6781	0.0001	
ADLTMALE	1	3.649667	0.224437	16.2614	0.0001	
RURAL	1	-1.761003	0.149416	-11.7859	0.0001	
SMALL	1	-0.896786	0.149334	-6.0052	0.0001	
INCOME1	1	1.718374	0.162616	10.5670	0.0001	
INCOME2	1	0.813938	0.120068	6.7790	0.0001	
PENAT1	1	1.951664	0.074595	26.1635	0.0001	

S T A T I S T I C A L A N A L Y S I S S Y S T E M 16:35 FRIDAY, MARCH 4, 1983 2

MODEL: MODEL01

DEP VAR: RLEAD RESIDUALS

SSE	209491.6	F RATIO	9.56
DFE	8551	PROB>F	0.0001
MSE	24.499062	R-SQUARE	0.0509

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>|T|	VARIABLE LABEL
INTERCEPT	1	-0.284263	0.091100	-3.1203	0.0018	
CITY2	1	-1.306009	0.445213	-2.9334	0.0034	
CITY3	1	-0.503802	0.598570	-0.8417	0.4000	
CITY4	1	-0.990689	0.521277	-1.9005	0.0574	
CITY5	1	2.145704	0.544540	3.9404	0.0001	
CITY6	1	2.219155	0.532513	4.1673	0.0001	
CITY7	1	0.568504	0.459098	1.2383	0.2156	
CITY8	1	-0.873100	0.472444	-1.8480	0.0646	
CITY9	1	-0.292115	0.500664	-0.5832	0.5598	
CITY10	1	-0.520559	0.438751	-1.1865	0.2355	
CITY11	1	-1.023718	0.421021	-2.4315	0.0151	
CITY12	1	1.472669	0.332875	4.4241	0.0001	
CITY13	1	-0.307339	0.416933	-0.7371	0.4611	
CITY14	1	4.226322	0.451987	9.3505	0.0001	
CITY15	1	0.401354	0.532513	0.7537	0.4511	
CITY16	1	0.546450	0.493829	1.1066	0.2685	
CITY17	1	-0.693248	0.428127	-1.6193	0.1054	
CITY18	1	0.316166	0.505732	0.6252	0.5319	
CITY19	1	2.215456	0.425239	5.2099	0.0001	
CITY20	1	-2.084353	0.429595	-4.8519	0.0001	
CITY21	1	0.749930	0.496139	1.5115	0.1306	
CITY22	1	-2.104753	0.445213	-4.7275	0.0001	
CITY23	1	-1.226951	0.421021	-2.9142	0.0036	
CITY24	1	1.495760	0.385059	3.8842	0.0001	
CITY25	1	-0.134537	0.535442	-0.2513	0.8016	
CITY26	1	-1.663936	0.554138	-3.0027	0.0027	
CITY27	1	2.833795	0.493829	5.7364	0.0001	
CITY28	1	2.060655	0.616034	3.3450	0.0008	
CITY29	1	-0.487980	0.554138	-0.8806	0.3786	

TEH 0533106

DUP050034376

CITY32	1	0.572656	0.541454	1.0576	0.2905
CITY33	1	-0.101136	0.505732	-0.2000	0.8415
CITY34	1	-0.353642	0.405394	-0.8723	0.3830
CITY35	1	0.076454	0.416933	0.1834	0.8545
CITY36	1	0.050068	0.418282	0.1197	0.9047
CITY37	1	0.981211	0.464670	2.1116	0.0347
CITY38	1	1.089230	0.564282	1.9303	0.0536
CITY39	1	0.711363	0.564282	1.2607	0.2078
CITY40	1	2.851585	0.468506	6.0865	0.0001
CITY41	1	0.597924	0.510751	1.1707	0.2418
CITY42	1	-0.230226	0.956908	-0.2406	0.8099
CITY43	1	2.270267	0.443569	5.1182	0.0001
CITY44	1	-0.609061	0.378034	-1.6111	0.1072
CITY45	1	0.370636	0.451967	0.8200	0.4122
CITY46	1	1.069330	0.491552	2.1754	0.0296
CITY47	1	1.452018	0.372308	3.9000	0.0001

0
0

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB > |T|	VARIABLE LABEL
CITY48	1	-0.867279	[illegible]	[illegible]	[illegible]	

TEH 0533107
DUP050034377

the effects one wants. Dr. Bradley expressed concern that our use of a limited number of statistically significant dummy variables undercontrolled for demographic representation compared to Ethyl's analysis.

We have, as noted above, performed analyses including site dummies and site interactions and time, and performed separate analysis on different subgroups, to address some of these issues. Dr. Pirkle's 144 variable model (Table 20) with all first order interactions also addresses Dr. Bradley's concerns. Dr. Pirkle has also run this expanded model separately for several age and race subgroups. They are also in Appendix IV of this document.

To further address Dr. Smith's concerns, we have performed another regression with changed definitions for some of the demographic variables. We have redefined our age groups as 0-8, 8-21, and 21 and over. Degree of urbanization has been redefined as well, with Big representing cities over 250,000, Small representing urban areas between 10,000 and 250,000 in population or Rural representing cities under 10,000 and rural areas.

We have considered but rejected the idea of changing the definition of sex and race.[1] These results (Table 21), as expected, agree with the previous analyses, with gasoline explaining 7.6 gu/dl of mean blood lead.

We have also rerun our base model, which includes all variables that were statistically significant in SURREGR, other than time, with the natural log of individual's blood lead as the dependent variables. These results are on Table 22. The mean

---

1. In some states, the interaction of sex and race was illegal until recently.

Table 20

Appendix C

Multiple Regression Results for the Gasoline Lead Variable

Gasoline lead was entered as a linear term (GAS1), since previous analysis ha shown this to provide generally a better fit to the data than the squared ter. (2). The dependent variable is the natural log of blood lead. Variables which represented less than 30 samples have been excluded. Standard errors are included for completeness but they do not incorporate the effects of the complex survey design. Regression results are given for Blacks & Whites, Blacks, Whites, Whites .5-5 yrs, Whites 6-17 yrs and Whites 18-74 yrs.

GROUP: BLACK & WHITE

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB.
MODEL	108	9392684	86969.299	42.244	0.0001
ERROR	9596	19755540	2058.727		
C TOTAL	9704	29148225			
ROOT MSE		45.373192	R-SQUARE	0.3222	
DEP MEAN		2.556008	ADJ R-SQ	0.3146	
C.V.		1775.158			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROBABILITY
INTERCEP	1	1.931798	0.064307	30.040	0.0001
GAS1	1	1.408876	0.063584	22.158	0.0001
MALE	1	0.261253	0.028768	9.081	0.0001
SMALL	1	-0.144321	0.051890	-2.781	0.0054
RURAL	1	-0.200562	0.050244	-3.992	0.0001
MALESMAL	1	0.038549	0.020667	1.865	0.0622
MALERURL	1	0.106573	0.022732	4.688	0.0001
MALECHILD	1	-0.232952	0.070949	-3.283	0.0010
MALETEEN	1	-0.121727	0.035557	-3.423	0.0006
CENTER	1	0.102237	0.037963	2.693	0.0071
TEENRURL	1	0.064181	0.038687	1.659	0.0971
MALECEN	1	-0.010045	0.017274	-0.582	0.5609
SMALLCEN	1	0.026586	0.020493	1.297	0.1945
CHILD	1	0.162753	0.073243	2.222	0.0263
TEEN	1	-0.013349	0.039076	-0.342	0.7326
CHILDSMAL	1	0.024682	0.074914	0.329	0.7418
TEENSMAL	1	-0.058684	0.036911	-1.5[illegible]	0.1107
CHILDRURAL	1	0.047401	0.074918	0.633	0.5269
CHILDCEN	1	0.084344	0.040478	2.084	0.0372
TEENCEN	1	0.081796	0.021822	3.748	0.0002
INCOME1	1	-0.052702	0.048486	-1.087	0.2771
INCOME2	1	-0.026729	0.030642	-0.872	0.3831
MALEINC1	1	0.006370338	0.026838	0.237	0.8124
MALEINC2	1	0.059071	0.017306	3.413	0.0006
CHILDINC1	1	0.254724	0.109362	2.329	0.0199

CHILDINC2	1	0.185470	0.074143	[illegible]	0.0124
TEENINC1	1	0.166734	0.072013	[illegible]	[illegible]
TEENINC2	1	0.064511	0.038407	[illegible]	[illegible]
SMALLIN1	1	0.045261	0.034346	[illegible]	0.1876
SMALLIN2	1	-0.031361	0.022193	[illegible]	0.1577
RURALIN1	1	0.145481	0.040148	[illegible]	0.0003
RURALIN2	1	0.035110	0.024304	[illegible]	0.1486
INC1CEN	1	0.125199	0.028874	[illegible]	0.0001
INC2CEN	1	0.044674	0.018726	[illegible]	0.0171
NORTHEST	1	0.031087	0.058552	[illegible]	0.5955
MIDWEST	1	0.012956	0.063212	[illegible]	0.8376
SOUTH	1	-0.074607	0.061220	[illegible]	0.2230
WINTER	1	0.005362109	0.060565	[illegible]	0.9295
SPRING	1	-0.050764	0.031231	[illegible]	0.1041
SUMMER	1	-0.043379	0.070044	[illegible]	0.5357
NORTSUMM	1	-0.145331	0.063938	-2.273	0.0230
MALENORT	1	0.034003	0.023630	[illegible]	0.1502
CENTNORT	1	-0.120198	0.032389	-3.711	0.0002
CHILDNORT	1	-0.018204	0.053444	-0.341	0.7334
TEENNORT	1	-0.068657	0.029052	-2.363	0.0181
SMALNORT	1	0.017722	0.052380	0.338	0.7351
RURLNORT	1	-0.0091163	0.051708	[illegible]	0.8601
INC1NORT	1	-0.094198	0.041525	-2.268	0.0233
INC2NORT	1	0.003014538	0.025573	0.118	0.9062
MIDWSPRI	1	-0.00984422	0.062461	-0.158	0.8748
MIDWSUMM	1	-0.139198	0.066452	-2.095	0.0362
MALEMIDW	1	0.020501	0.023408	0.876	0.3812
CENTMIDW	1	0.031273	0.033190	0.942	0.3461
CHILDMIDW	1	-0.052516	0.052298	-1.004	0.3153
TEENMIDW	1	-0.114099	0.028941	-3.942	0.0001
SMALMIDW	1	-0.075110	0.051475	-1.459	0.1446
RURLMIDW	1	0.038214	0.051827	0.737	0.4609
INC1MIDW	1	-0.041658	0.038907	-1.071	0.2843
INC2MIDW	1	0.007096011	0.025408	0.279	0.7800
SOUTWINT	1	0.001092343	0.058629	0.019	0.9851
SOUTSPRI	1	-0.074399	0.059121	-1.258	0.2083
MALESOUT	1	0.045872	0.020554	2.232	0.0256
CENTSOUT	1	0.012187	0.028922	0.421	0.6735
CHILDSOUT	1	0.034920	0.045584	0.766	0.4437
TEENSOUT	1	-0.106848	0.025010	-4.272	0.0001
SMALSOUT	1	0.055756	0.037608	1.483	[illegible]
RURLSOUT	1	0.019274	0.038810	0.497	[illegible]
INC1SOUT	1	[illegible]	0.033785	0.381	[illegible]
INC2SOUT	1	0.037469	0.022129	[illegible]	[illegible]
MALEWINT	1	0.024077	0.023819	1.011	[illegible]
CENTWINT	1	-0.149661	0.036016	-4.155	0.0001
CHILDWINT	1	-0.041283	0.052496	-0.786	0.4316
TEENWINT	1	-0.053129	0.029133	-1.824	0.0682
SMALWINT	1	-0.024507	0.044663	-0.549	0.5832
RURLWINT	1	-0.062305	0.041719	-1.493	0.1354
INC1WINT	1	-0.047007	0.037483	-1.254	0.2099
INC2WINT	1	0.013719	0.025888	0.530	[illegible]

MALESPRI	1	[illegible]45	0.021448	1.005	0.3151
CENTSPRI	1	[illegible]12083	0.029749	-3.768	0.0002
CHILDSPRI	1	-0.020503	0.051109	-0.401	0.6883
TEENSPRI	1	- .042646	0.026198	-1.628	0.1036
SMALSPRI	1	[illegible]81038	0.057075	1.420	0.1557
RURLSPRI	1	[illegible]2869[illegible]	0.056282	0.513	0.6077
INC1SPRI	1	-0.035864	0.035972	-0.997	0.3188
INC2SPRI	1	[illegible]16346	0.023434	0.698	0.4855
MALESUMM	1	[illegible]96674	0.021847	0.043	0.9653
CENTSUMM	1	[illegible].102016	0.030693	-3.324	0.0009
CHILDSUMM	1	.7584174	0.052543	0.144	0.8852
TEENSUMM	1	[illegible].013983	0.026401	-0.530	0.5964
SMALSUMM	1	[illegible].180571	0.029939	6.031	0.0001
RURLSUMM	1	0.063120	0.030785	2.050	0.0404
INC1SUMM	1	0.115469	0.042031	2.747	0.0060
INC2SUMM	1	0.011841	0.023412	0.506	0.6130
MA_CH_SM	1	[illegible].064467	0.079356	-0.812	0.4166
MA_CH_RU	1	-0.143693	0.082312	-1.746	0.0809
MA_TE_SM	1	0.011600	0.041895	0.277	0.7819
MA_TE_RU	1	-0.113820	0.043089	-2.642	0.0083
MA_CH_N1	1	-0.029082	0.103766	-0.280	0.7793
MA_CH_N2	1	-0.076251	0.067275	-1.133	0.2571
MA_TE_N1	1	0.027675	0.061898	0.447	0.6548
MA_TE_N2	1	-0.087877	0.035489	-2.476	0.0133
KI_SM_N1	1	-0.016876	0.121718	-0.139	0.8897
KI_SM_N2	1	-0.066304	0.085933	-0.772	0.4404
KI_RU_N1	1	-0.038820	0.140410	-0.276	0.7822
KI_RU_N2	1	-0.106637	0.087755	-1.215	0.2243
TE_SM_N1	1	0.018089	0.077408	0.234	0.8152
TE_SM_N2	1	0.049850	0.044152	1.129	0.2589
TE_RU_N1	1	-0.020203	0.081335	-0.248	0.8038
TE_RU_N2	1	0.018974	0.045417	0.418	0.6761

NOTE: THE PROCEDURE SURREGR USED 26.77 SECONDS ...
NOTE: SAS INSTITUTE INC.
SAS CIRCLE
PO BOX 8000
CARY, N.C. 27511-8000

Table 21

1 SAS 11:00 THURSDAY, MARCH 17

MODEL NUMBER 1
0THE RANK OF X'X IS 11 WITH 8600 OBSERVATIONS IN THE ANALYSIS
0THE CHECKS ON THE X'X INVERSE RESULTED IN A MAXIMUM RELATIVE DEVIATION OF 0.35928619D-07
THIS OCCURED IN ROW 8 AND IN COLUMN 7. THE TOLERANCE USED WAS 0.10000000D-05
0
1MODEL NUMBER 1
0BETA VALUES FOR DEPENDENT EFFECT

LEAD

INTERCPT	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	PB1
4.23792	-1.39874	2.68986	2.1496	4.4675	0.541932	-1.4604	-1.48397	1.43571	0.63513	1.89575

0OLS VARIANCES OF BETAS
0

INTERCPT	TEEN	TEENMALE	KID	ADLTMALE	MALE	RURAL	SMALL	INCOME1	INCOME2	PB1
0.114494										
-.006932	.0340359									
-3.4E-04	-.025683	0.175445								
-.006339	.0082512	0.065161	.0734212							
-.008523	.0083076	0.124494	.0734153	0.141602						
-7.1E-05	-6.3E-05	-.124406	-.065154	-.124462	0.12441					
-.014379	-8.6E-04	-3.4E-04	-9.4E-04	-9.1E-04	4.2E-04	.0150959				
-.012559	-0.0011	2.4E-04	-6.1E-04	-4.8E-04	5.0E-04	.0060373	.0225858			
-.006921	.0013578	9.4E-04	.0019102	.0026209	-6.4E-04	-.001351	-.001871	.0297477		
-.004536	.0010062	4.9E-04	8.6E-05	.0010551	-2.7E-04	-.001062	-9.2E-04	.0060605	.0134884	
-.022575	-3.0E-04	1.8E-05	-3.9E-04	3.9E-06	3.4E-06	.0017699	.0013079	1.7E-04	-3.0E-04	.0051454

1HYPOTHESIS TESTING RESULTS
0MODEL NUMBER 1
0 8589 DENOMINATOR DEGREES OF FREEDOM

0DEPENDENT EFFECT	F VALUE	DEGREES OF FREEDOM	PROBABILITY
LEAD			
TEST FOR OVERALL MODEL	300.29	10	1.0000
0INDEPENDENT EFFECTS			
TEEN	57.48	1	1.0000
TEENMALE	41.24	1	1.0000
KID	62.94	1	1.0000
ADLTMALE	140.95	1	1.0000
MALE	2.36	1	0.8756
RURAL	141.28	1	1.0000
SMALL	97.50	1	1.0000
INCOME1	69.29	1	1.0000
INCOME2	29.91	1	1.0000
PB1	698.46	1	1.0000

TEH 0533112

ENT EFFECT

```
MALE KID      ADLTMALE MALE     RURAL     SMALL     INCOME1  INCOME2  PB1

E986   2.1496   4.4675 0.541932  -1.4604  -1.48397  1.43571  0.63513  1.89575
RORS

MALE KID      ADLTMALE MALE     RURAL     SMALL     INCOME1  INCOME2  PB1


3447
308 0.126693
887 .0441775 0.121808
712 -.036347 -.098979 0.101073
973 .0020623 0.031742 -.010751 .0949942
519 -.012666 0.021133 -.004945 .0550044 .0866767
024 -0.00768   0.0294 -0.01495 .0487348 .0178409 0.092339
165 0.010375 .0134398 -.011044 -.003652 .0058439 .0033433 .0210324
036 .0232442 .0044443 -7.9E-04 0.003166 .0079036 -.007856 0.002253 .0332675
.TS

DEGREES OF FREEDOM
F  VALUE        DEGREES OF FREEDOM  PROBABILITY


  141.83              10              0.0000


   45.38               1              0.0000
   33.90               1              0.0000
   36.47               1              0.0000
  163.85               1              0.0000
    2.91               1              0.0930
   22.45               1              0.0000
   25.41               1              0.0000
   22.32               1              0.0000
   19.18               1              0.0001
  108.03               1              0.0000
LATED THAT    25K WAS NEEDED FOR ARRAY STORAGE
```

```
-6.1E-04  6.6E-05  3.7E-04  2.4E-04  5.4E-04
 4.2E-04 -1.4E-05 -3.7E-04 -1.5E-04 -4.2E-04  6.1E-04
-2.0E-04 -3.1E-05  9.0E-05  7.3E-05  1.0E-04 -1.3E-04  7.6E-04
 2.8E-04 -1.3E-04  1.4E-05 -6.7E-05  4.3E-05 -3.1E-06  4.7E-04  7.0E-04
 7.5E-05  6.0E-05 -4.5E-06  6.3E-05  2.0E-05 -2.4E-05  1.4E-04  1.9E-05  3.4E-04
-9.4E-05  7.8E-05 -2.5E-05  9.2E-06 -5.1E-06  1.1E-05 -4.2E-05 -6.2E-05  3.6E-05  9.9E-05
-6.6E-04  8.4E-05  7.2E-05  1.1E-04  9.5E-05 -7.6E-05 -6.2E-05 -1.6E-04 -4.0E-05  2.4E-05  2.1E-04
1HYPOTHESIS TESTING RESULTS
0MODEL NUMBER   1
0        32 DENOMINATOR DEGREES OF FREEDOM
0DEPENDENT EFFECT        F  VALUE          DEGREES OF FREEDOM  PROBABILITY

 LLEAD

 TEST FOR OVERALL MODEL   232.36              10              0.0000
0INDEPENDENT EFFECTS

 TEEN                       6.41               1              0.0165
 TEENMALE                  26.61               1              0.0000
 KID                      121.94               1              0.0000
 ADLTMALE                 104.15               1              0.0000
 MALE                       5.61               1              0.0218
 RURAL                     18.32               1              0.0002
 SMALL                      8.22               1              0.0073
 INCOME1                   12.47               1              0.0013
 INCOME2                   14.31               1              0.0006
 FP1                      107.36               1              0.0000
0NOTE- THE PROCEDURE CALCULATED THAT    25K WAS NEEDED FOR ARRAY STORAGE
COMMAND?
```

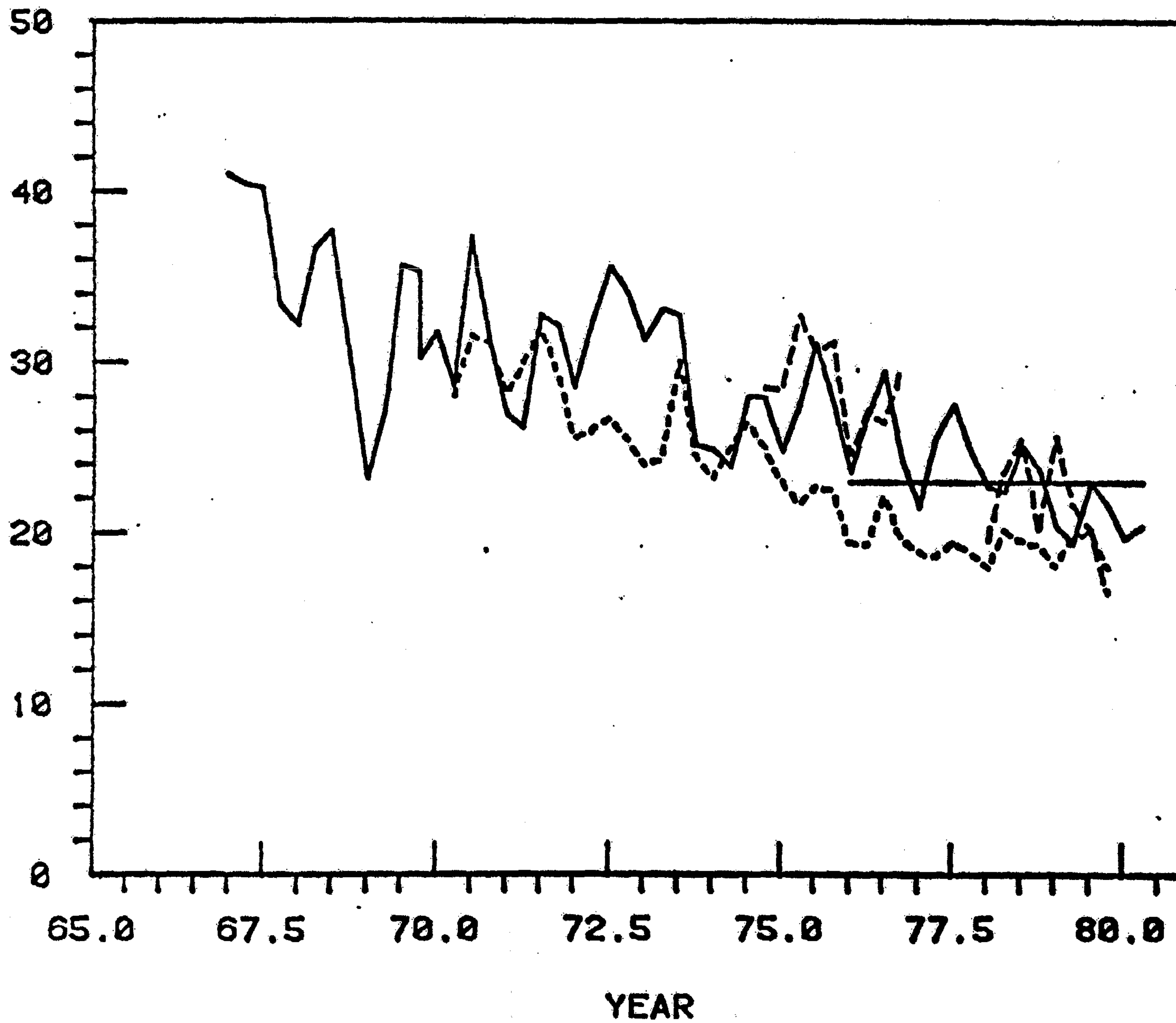
TEH 0533114

DUP050034384

gasoline usage during the NHANES period explains the mean blood lead in this model. Again, the agreement and consistency of the amount of blood lead due to gasoline among all of these models is striking, and, we believe, supports the conclusion that air lead sources contributed two to three times the 3 ug/dl to blood lead that was estimated in 1977-78 during the previous EPA standard setting.

Further support for the hypothesis that this phenomenon is not an artifact of the choice of subgroups are the enclosed graphs from Dr. Billich's analyses. Figure 1 shows the geometric mean blood lead levels for black children screened in New York, Chicago, and Louisville during the 1970s. The mean NHANES blood lead (which was all that was released when Dr. Billich did his analysis) for black children in shown for comparison. This indicates a consistent trend in three cities, based on several hundred thousand blood lead screens. Figure 2 shows the same data for the percent of children over 30 ug/dl. Again, the trend is clear. Figure 3 shows the results of several hundred thousand black and Hispanic blood lead tests, and gasoline lead in New York City. Figures 4, 5, 6, and 7 show these results broken down into age 0-1, 1-2, 2-3, and over 6, demonstrating a consistency across ages. Finally, I have updated the graphs of the national and Providence screening results that were in my previous paper to show two additional quarters of data. They indicate downward shifts of blood lead due to the two regulatory changes. All of these provide secondary reassurance that the relationship between gasoline lead and blood lead is not an artifact of sampling.

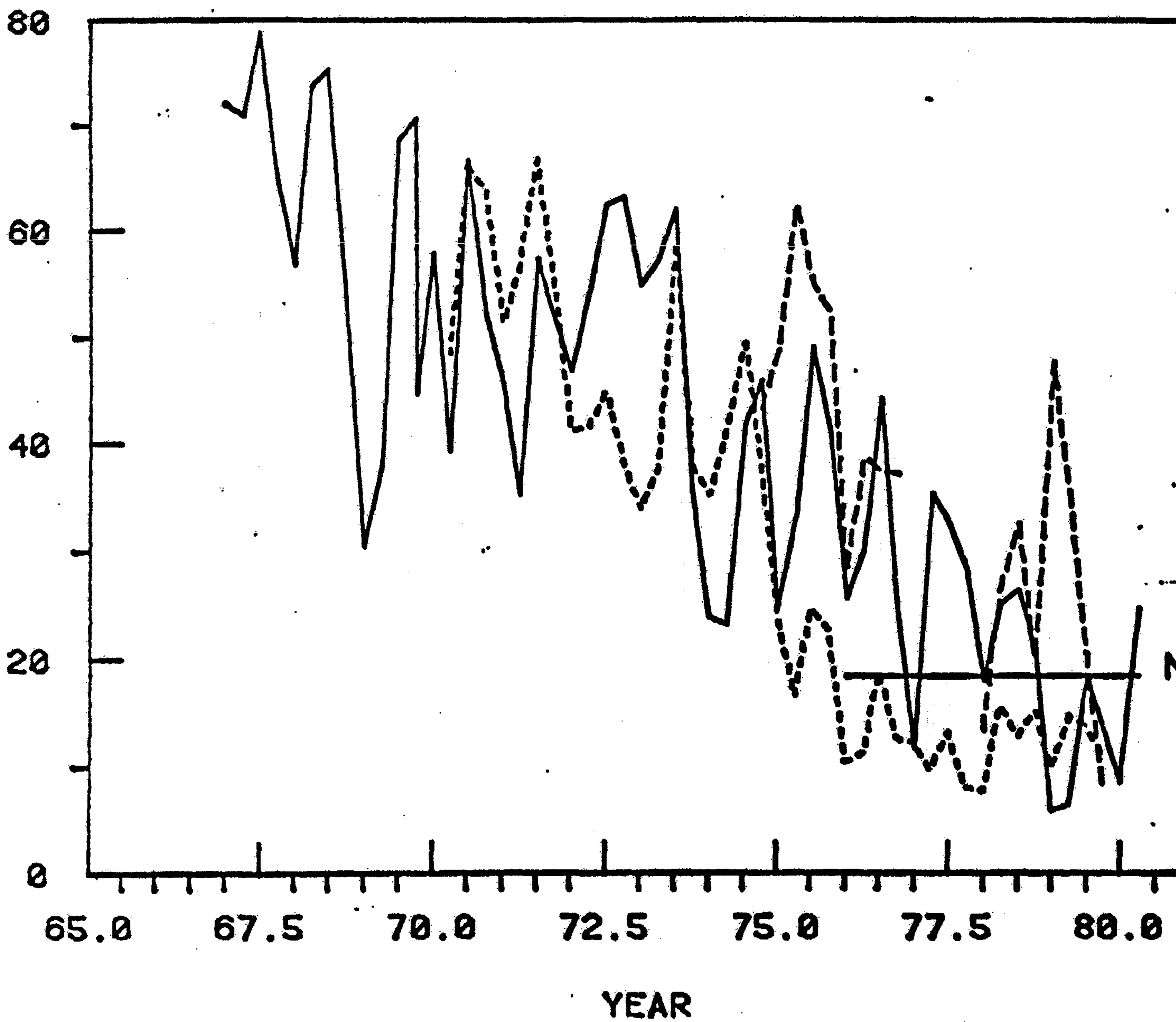
TIME DEPENDENCE OF BLOOD LEAD



SOLID CHICAGO DOT NEW YORK DASH LOUISVILLE

FIGURE 1 ALL CITIES BLACKS, 24-35 MONTHS

TIME DEPENDENCE OF BLOOD LEAD



SOLID CHICAGO DOT NEW YORK DASH LOUISVILLE
FIGURE 2 ALL CITIES BLACKS, 24-35 MONTHS

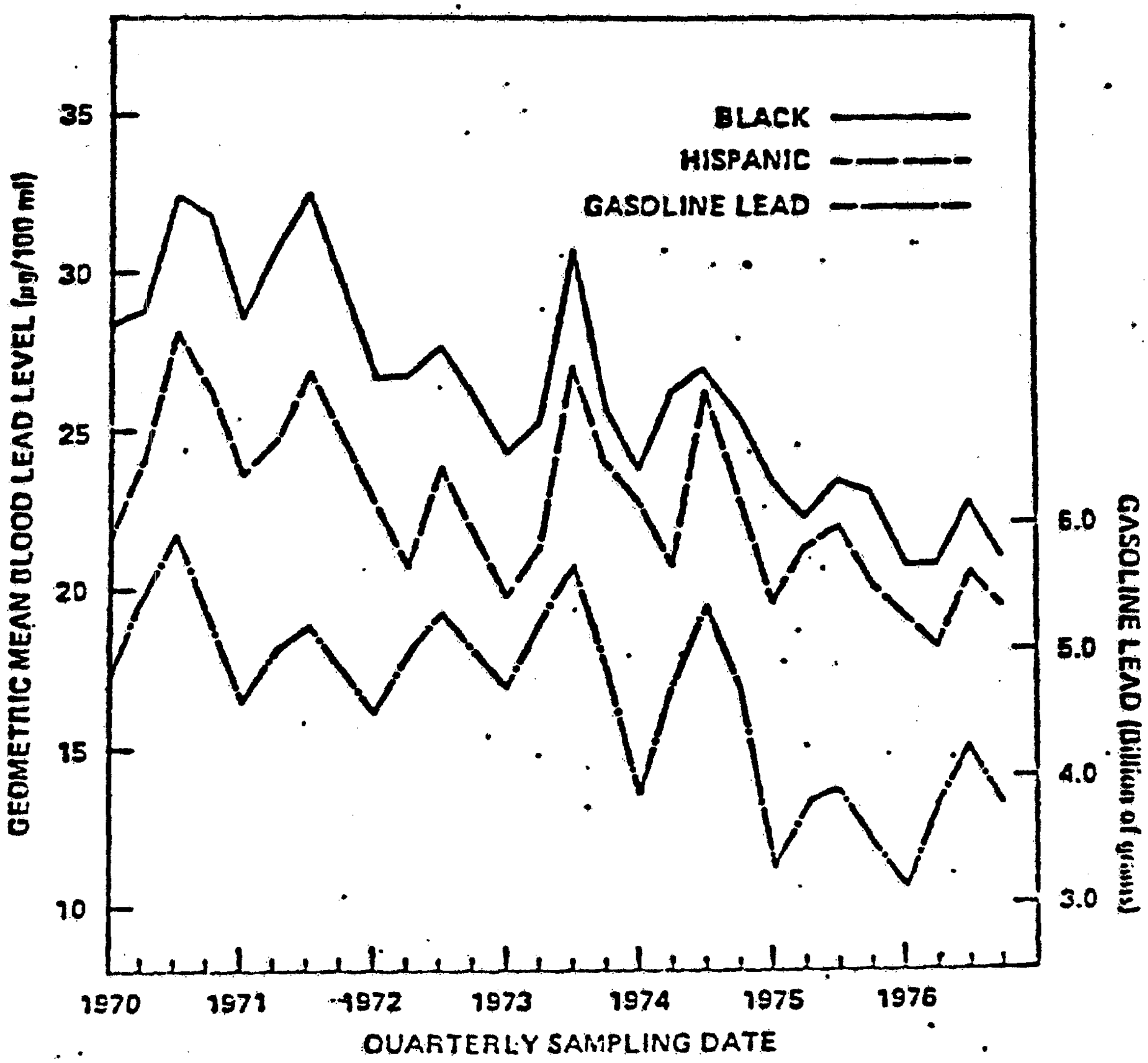
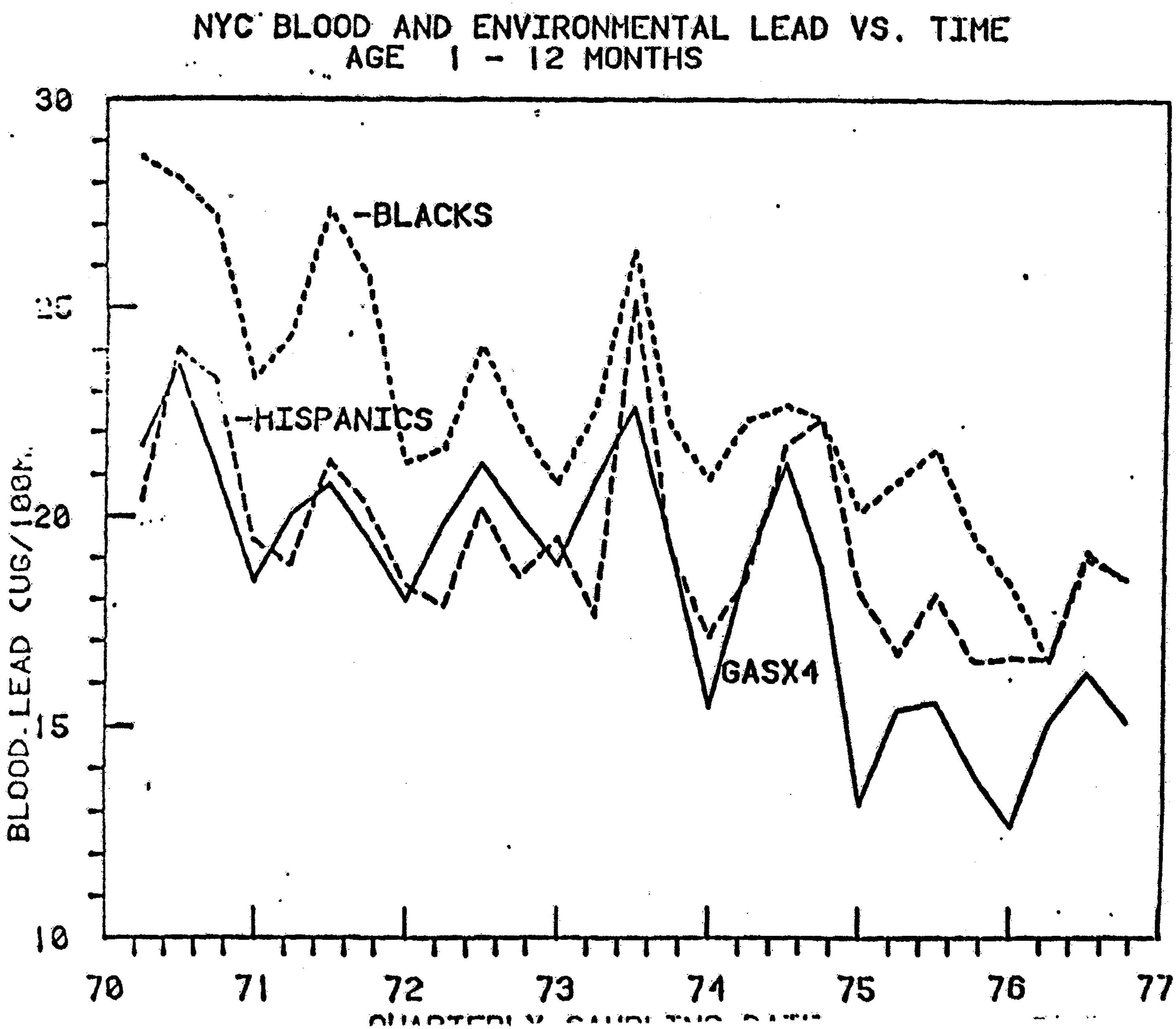


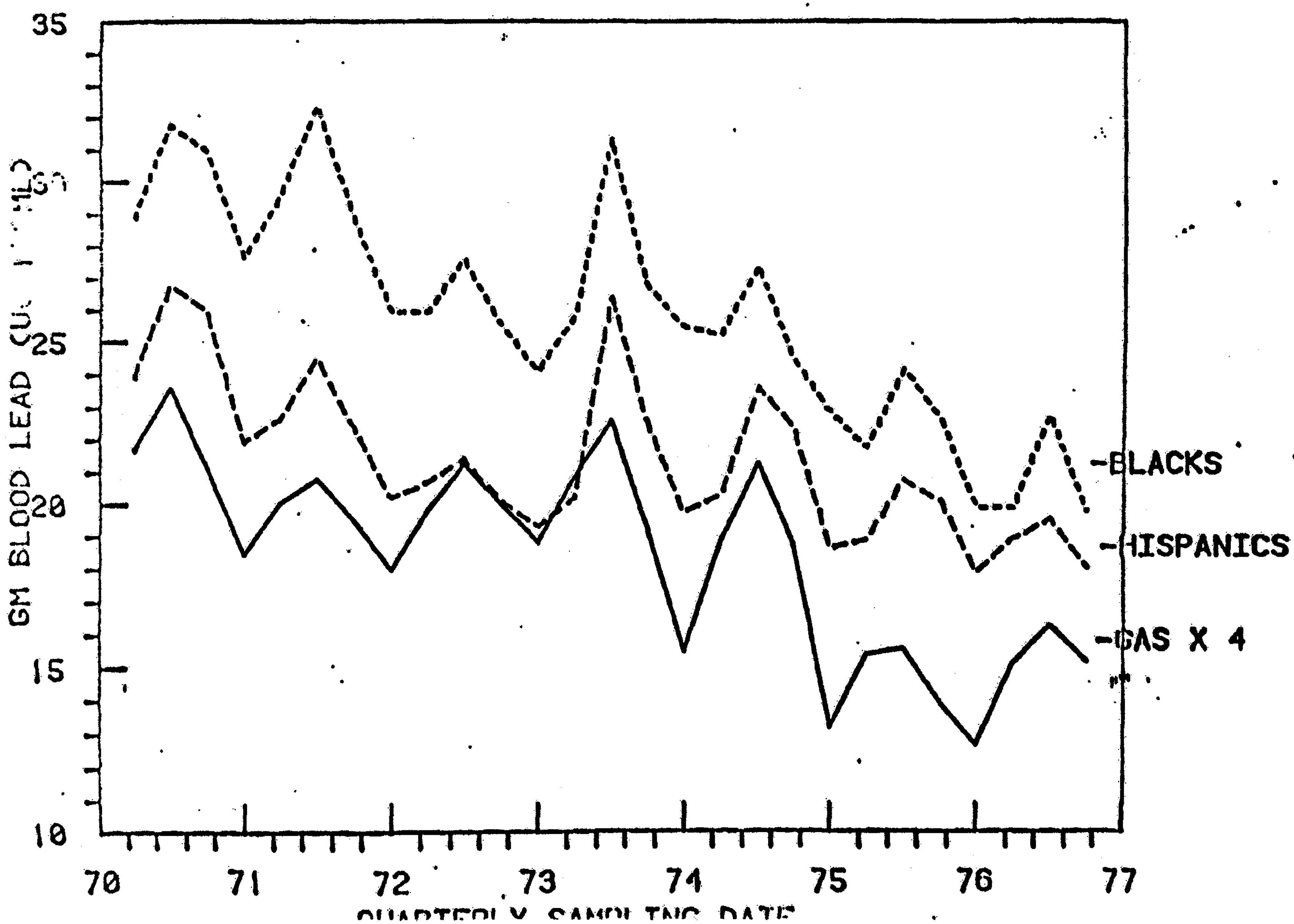
Fig. 3

TEH 0533118

DUP050034388


NYC BLOOD AND ENVIRONMENTAL LEAD VS. TIME
AGE 1 - 12 MONTHS
-BLACKS
-HISPANICS
GASX4
BLOOD LEAD (UG/100M
30
20
15
10
70
71
72
73
74
75
76
77

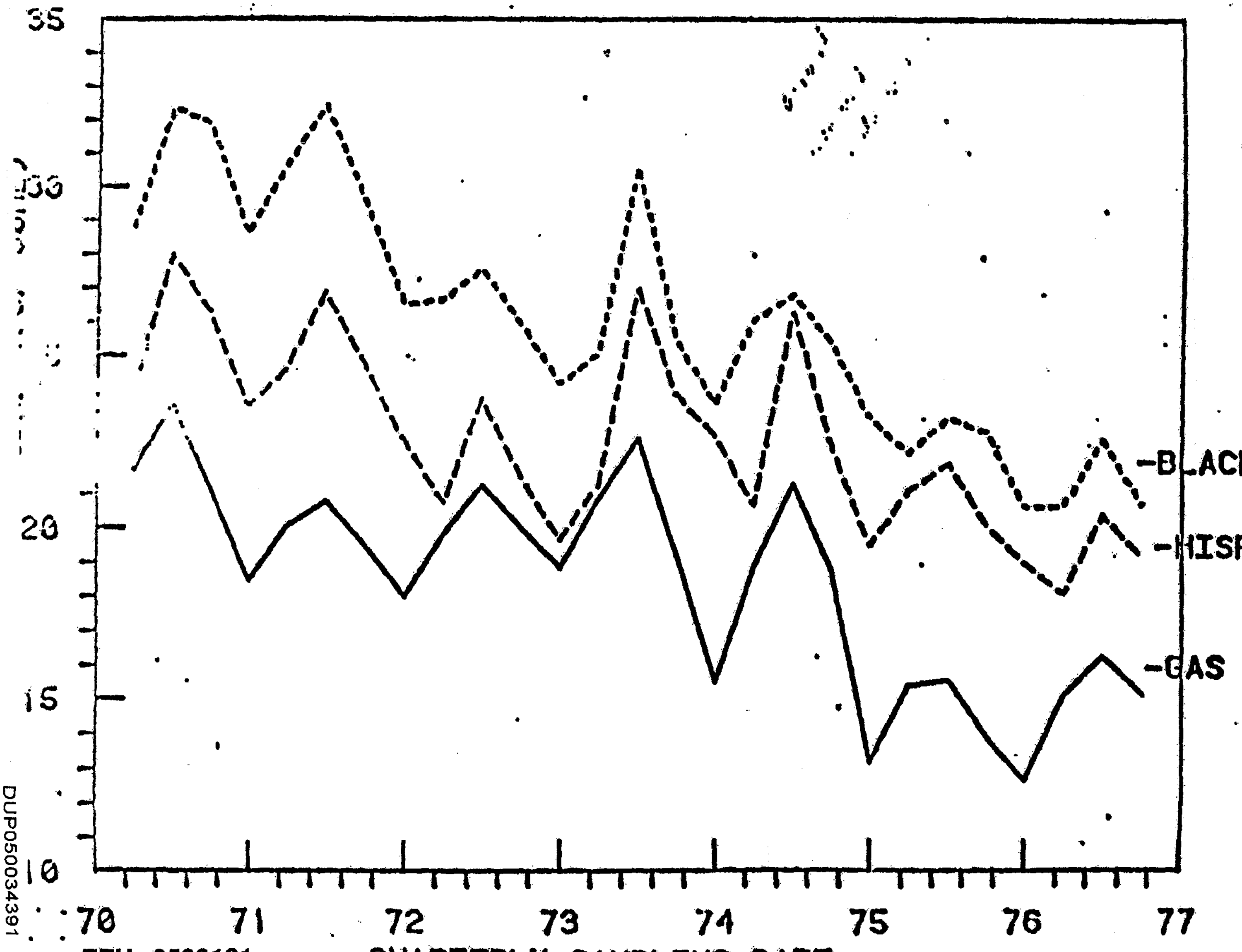
NYC BLOOD AND ENVIRONMENTAL LEAD VS. TIME
AGE 12-24 MONTHS



TEH 0533120

DUP050034390

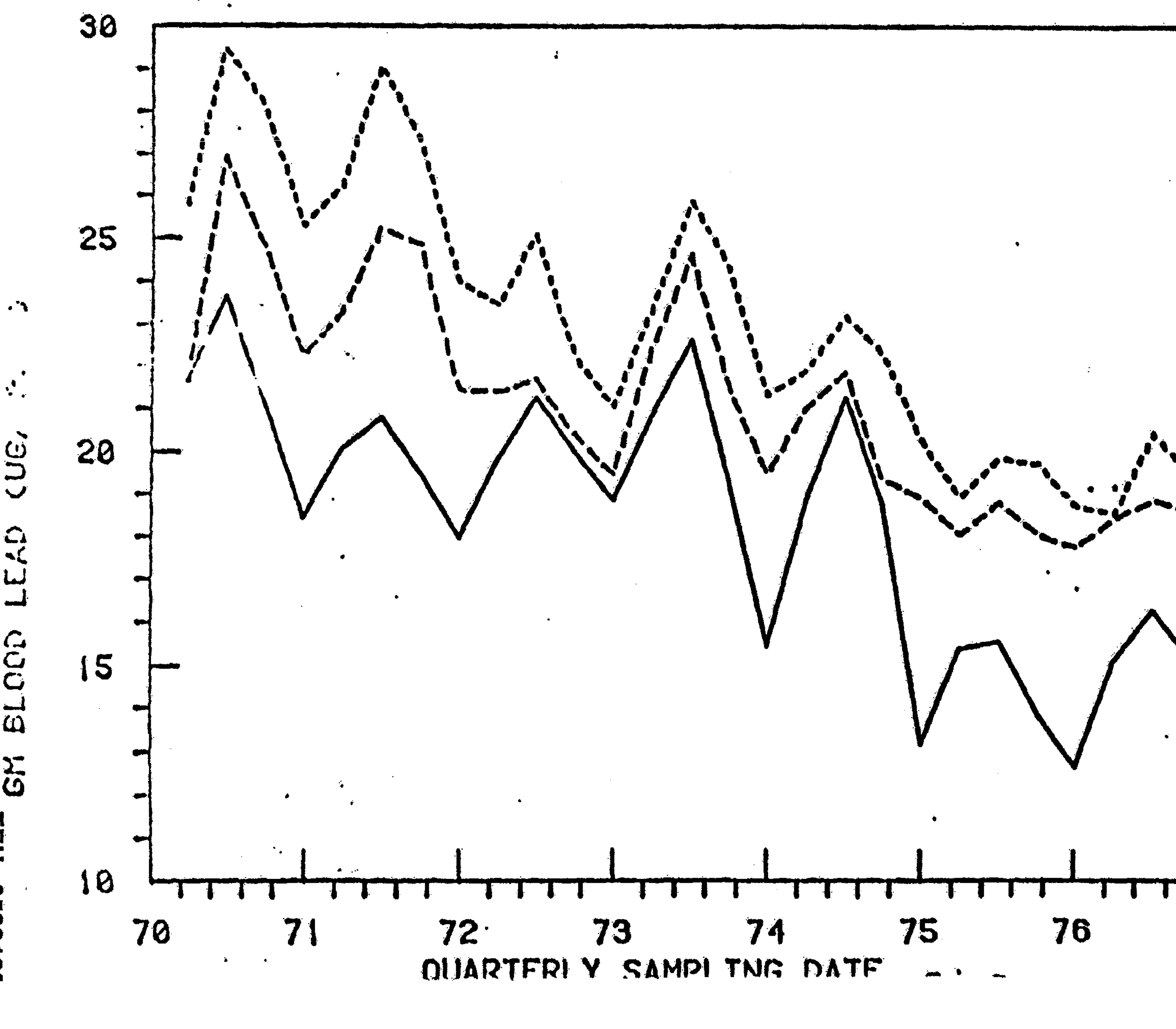
NYC BLOOD AND ENVIRONMENTAL LEAD VS. TIME
AGE 25-36 MONTHS

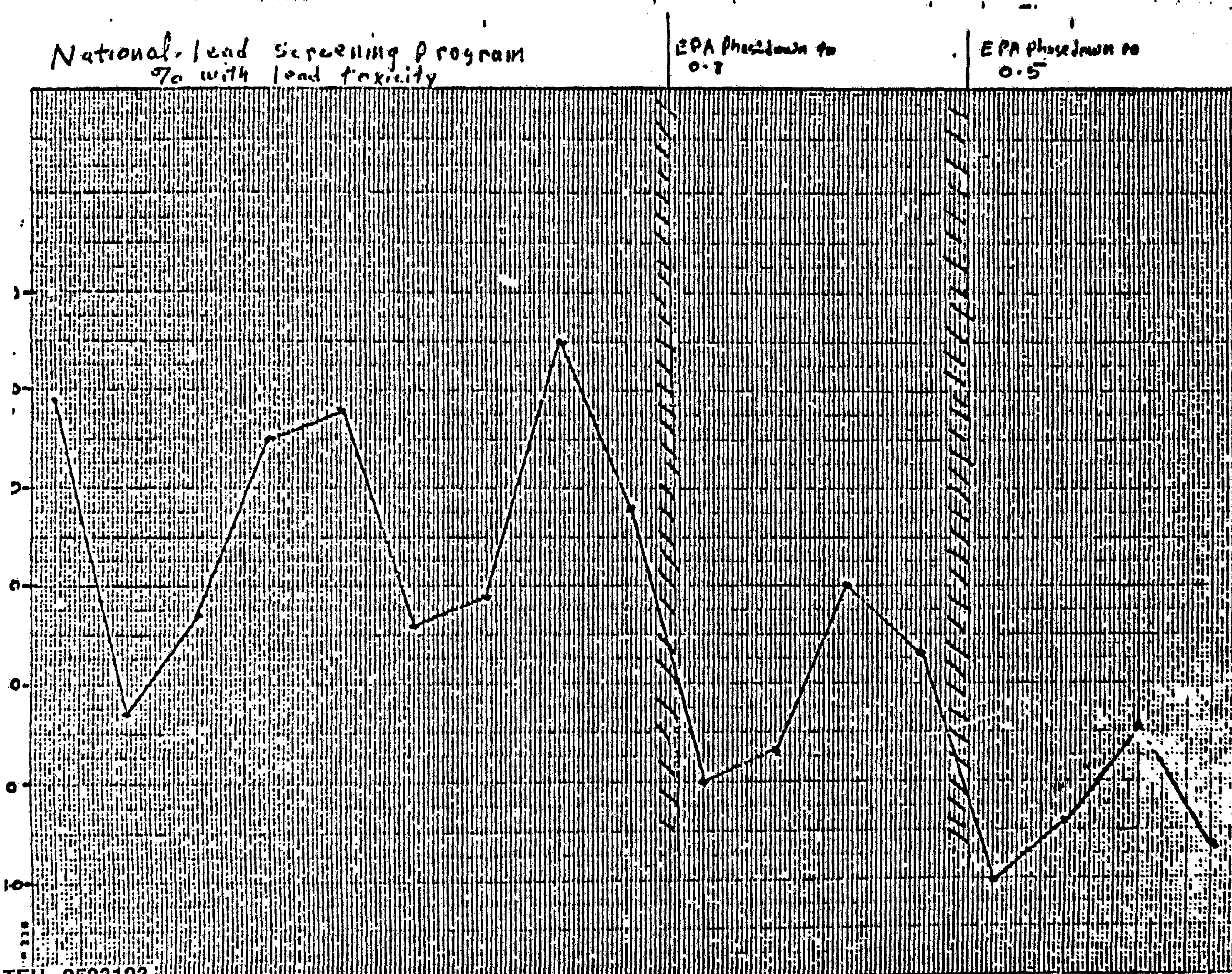


TEH 0533121

DUP05003439

NYC BLOOD AND ENVIRONMENTAL LEAD VS. TIME
AGE 72+ MONTHS

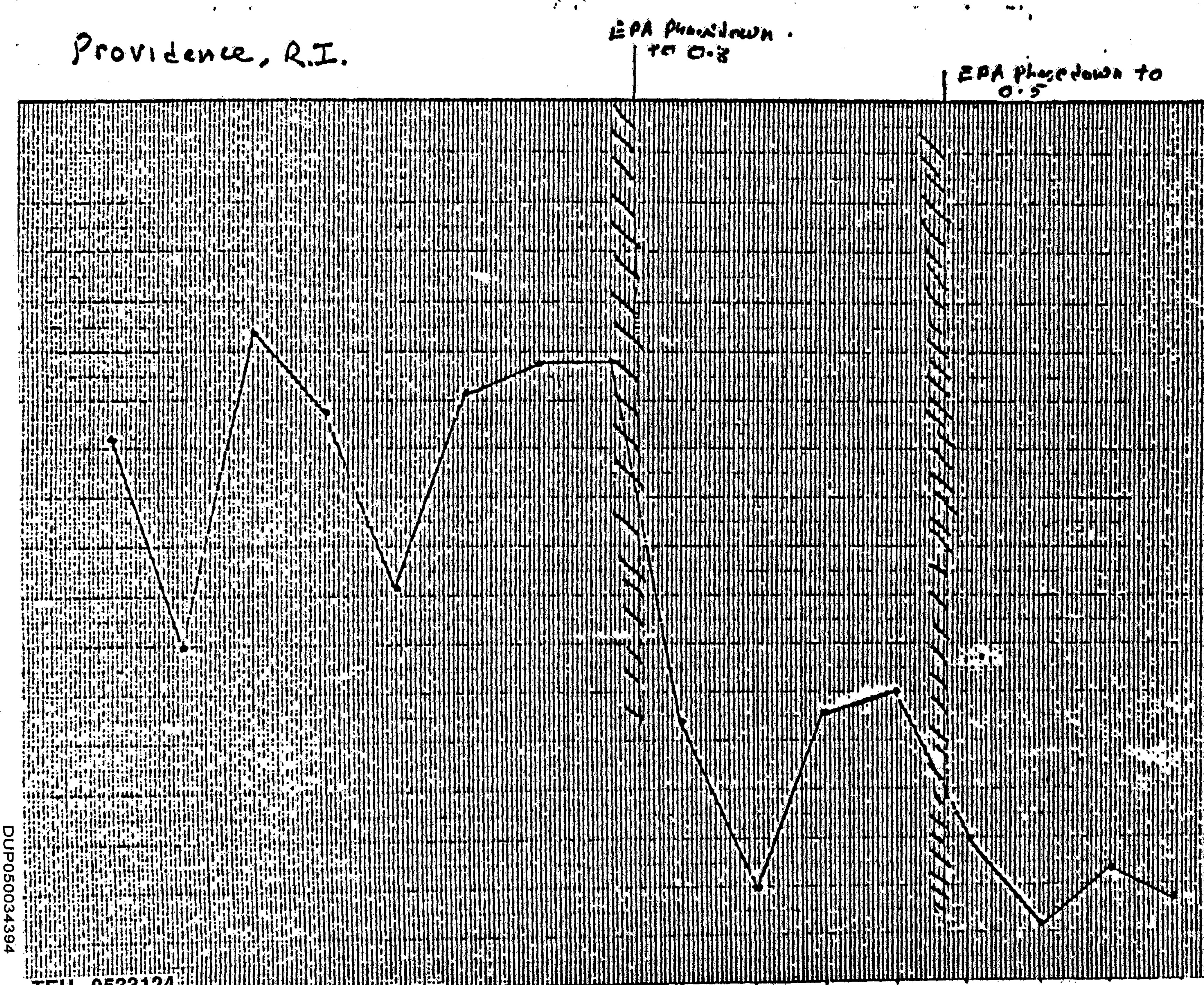




TEH 0533123

DUP050034393

Providence, R.I.



TEH 0533124

DUP050034394

Response to Other Comments

Dr. Bradley and others have made several comments about our analysis. I would like to respond to them briefly. We had already examined time as an explanatory variable by the time we received Dr. Bradley's comments. He obviously received only an earlier draft of our analysis. Dr. Bradley remarked that we had not used individual data in our regression, which biased results. We regret that lack of clarity in our paper lead him to this conclusion. In fact, all of our regressions were on individual data. Again, he states that we dismissed lead in food as a causal variable by remarking that it could not have changed enough to produce the effect. Dr. Bradley appears to have missed the section in our report where we tabulated food in the diet for three age groups in the 1970s. As we pointed out in that section, food lead appears to have increased slightly over the period, despite the reduction in lead solder in canned food noted by Ethyl.

In our original report, we used regressions for New York, Chicago, and Louisville to verify that season was not statistically significant when gasoline was included. Our December report also includes SURREGR runs on the NHANES data showing season is insignificant in that analysis as well. We regret any imprecision in our statement in the October report. We believe that the lack of significance in 6 single city regressions (3 cities separately for two races) and in the NHANES regressions were reason enough to drop these variables. Obviously more detailed analysis can be done, but we believe our approach was reasonable. Ethyl does not appear to have investigated season in their report at all.

Conclusion

The issue for the EPA Criteria Document is to assess how much blood lead may be due to air emissions, counting direct and indirect pathways. We believe the regressions presented here and in or December 1982 report are sufficient to conclude that during 1976-80, 6-8 ug/dl of blood lead in the average American was due to air emissions (gasoline lead is about 90% of air emissions).

APPENDIX I

Expanded regressions using city dummies

and city by gas interactions.

Whites with city dummies and time, expanded model with small city, kid x gas and rural x gas interactions

MODEL: MODEL01		SSE	2850532018	F RATIO	57.03
WEIGHT: WEIGHT		DFE	8539	PROB>F	0.0001
DEP VAR: LEAD		MSE	450924.8	R-SQUARE	0.2861

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>:T:
INTERCEPT	1	6.184827	0.873065	7.0863	0.0001
KID	1	3.368578	1.376385	2.4474	0.0144
TEEN	1	-0.708581	0.188080	-3.7674	0.0002
TEENMALE	1	1.488396	0.534054	2.7870	0.0053
ADLTMALE	1	4.264116	0.497190	8.5764	0.0001
RURAL	1	0.456727	0.787054	0.5803	0.5617
SMALL	1	-0.198671	0.342357	-0.5809	0.5613
MALE	1	0.712338	0.481250	1.4802	0.1389
INCOME1	1	1.233564	0.174614	7.0645	0.0001
INCOME2	1	0.652144	0.116109	5.6166	0.0001
RURALGAS	1	-0.287054	0.168037	-1.7083	0.0876
KIDGAS	1	-0.080630	0.312656	-0.2579	0.7965
TIME	1	-1.676502	0.244721	-6.8507	0.0001
PBNAT1	1	1.260829	0.185944	6.7807	0.0001
CITY2	1	-0.906869	0.390659	-2.3214	0.0203
CITY3	1	-0.601747	0.587206	-1.0248	0.3055
CITY4	1	-0.659102	0.566113	-1.1643	0.2444
CITY5	1	2.021306	0.509553	3.9668	0.0001
CITY6	1	1.570698	0.586276	2.6791	0.0074
CITY7	1	0.834672	0.495990	1.6828	0.0924
CITY8	1	-0.403261	0.487762	-0.8268	0.4084
CITY9	1	-1.426314	0.506156	-2.8179	0.0048
CITY10	1	0.191669	0.528693	0.3625	0.7170
CITY11	1	-1.060867	0.457907	-2.3168	0.0205
CITY12	1	-0.779963	0.394941	-1.9749	0.0483
CITY13	1	-0.750425	0.448356	-1.6737	0.0942
CITY15	1	1.669346	0.507006	3.2926	0.0010
CITY16	1	1.089661	0.531213	2.0513	0.0403
CITY17	1	-2.266233	0.474276	-4.7783	0.0001
CITY18	1	0.784261	0.575309	1.3632	0.1728
CITY19	1	0.622126	0.497514	1.2505	0.2112
CITY20	1	-1.082907	0.458929	-2.3596	0.0183
CITY21	1	-0.373429	0.578070	-0.6460	0.5183
CITY22	1	-1.211571	0.476599	-2.5421	0.0110
CITY23	1	-0.997523	0.587180	-1.6988	0.0894
CITY24	1	1.080762	0.419024	2.5792	0.0099
CITY25	1	-0.038262	0.646049	-0.0592	0.9528
CITY26	1	-1.943938	0.637559	-3.0490	0.0023
CITY27	1	3.275904	0.549364	5.9629	0.0001
CITY28	1	3.610662	0.647635	5.5751	0.0001
CITY29	1	0.071675	0.578469	0.1239	0.9014
CITY30	1	2.184445	0.496345	4.4011	0.0001
CITY31	1	-0.292448	0.531030	-0.5507	0.5818
CITY32	1	1.506223	0.483327	3.1164	0.0018
CITY33	1	0.476372	0.567422	0.8395	0.4012
CITY34	1	-0.772618	0.436902	-1.7684	0.0770
CITY35	1	0.245035	0.441365	0.5552	0.5788
CITY36	1	-0.319967	0.443505	-0.7215	0.4707
CITY37	1	0.209367	0.504318	0.4152	0.6780
CITY38	1	-0.835189	0.648121	-1.2886	0.1976
CITY39	1	-1.817713	0.526126	-3.4549	0.0006
CITY40	1	1.870289	0.474854	3.9387	0.0001
CITY41	1	0.722758	0.475232	1.5209	0.1283
CITY42	1	0.683352	0.969784	0.7046	0.4811
CITY43	1	2.783754	0.418208	6.6564	0.0001
CITY44	1	0.030044	0.436771	0.0688	0.9452
CITY45	1	-1.060403	0.509153	-2.0827	0.0373
CITY46	1	-0.344215	0.466036	-0.7386	0.4602
CITY47	1	0.474921	0.384820	1.2341	0.2172
CITY48	1	-0.563675	0.453303	-1.2435	0.2137
CITY49	1	1.026707	0.476366	2.1553	0.0312

COMMAND?

TEH 0533128

DUP050034398

L UNN

MODEL:	MODEL01	SSE	3852093221	F RATIO	59.97
WEIGHT:	WEIGHT	DFE	8542	PROB>F	0.0001
DEP VAR:	LEAD	MSE	450959.2	R-SQUARE	0.2858

Whites, with Time and City Dummies

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>:T:
INTERCEPT	1	6.755199	0.662472	10.1970	0.0001
KID	1	3.023615	0.356520	8.4809	0.0001
TEEN	1	-0.707892	0.187992	-3.7656	0.0002
TEENMALE	1	1.489997	0.534025	2.7901	0.0053
ADLTMALE	1	4.261738	0.497184	8.5718	0.0001
RURAL	1	-0.557536	0.138840	-4.0157	0.0001
MALE	1	0.712454	0.481246	1.4804	0.1388
INCOME1	1	1.231567	0.174589	7.0541	0.0001
INCOME2	1	0.650258	0.116041	5.6037	0.0001
TIME	1	-1.639302	0.243918	-6.7228	0.0001
PBNAT1	1	1.080540	0.152454	7.0876	0.0001
CITY2	1	-1.002569	0.386912	-2.5912	0.0096
CITY3	1	-0.454674	0.511597	-0.8887	0.3742
CITY4	1	-0.330465	0.478617	-0.6905	0.4899
CITY5	1	2.229714	0.473325	4.7107	0.0001
CITY6	1	1.945790	0.488241	3.9853	0.0001
CITY7	1	0.772670	0.493757	1.5649	0.1176
CITY8	1	-0.484616	0.485683	-0.9978	0.3184
CITY9	1	-1.239942	0.491047	-2.5251	0.0116
CITY10	1	0.410913	0.462711	0.8881	0.3745
CITY11	1	-1.010621	0.456069	-2.2159	0.0267
CITY12	1	-0.704331	0.391081	-1.8010	0.0717
CITY13	1	-0.611927	0.437527	-1.3966	0.1620
CITY15	1	1.759408	0.453769	3.8773	0.0001
CITY16	1	0.991930	0.528300	1.8776	0.0605
CITY17	1	-2.264497	0.474117	-4.7762	0.0001
CITY18	1	0.883837	0.478119	1.8486	0.0646
CITY19	1	0.713600	0.406163	1.7569	0.0790
CITY20	1	-1.128294	0.458211	-2.4624	0.0138
CITY21	1	-0.141832	0.490987	-0.2889	0.7727
CITY22	1	-0.899356	0.399943	-2.2487	0.0246
CITY23	1	-0.596378	0.486379	-1.2262	0.2202
CITY24	1	1.134119	0.417452	2.7166	0.0066
CITY25	1	0.230618	0.565381	0.4079	0.6834
CITY26	1	-1.699204	0.556423	-3.0538	0.0023
CITY27	1	3.579365	0.450065	7.9530	0.0001
CITY28	1	3.831496	0.570338	6.7179	0.0001
CITY29	1	0.366493	0.486088	0.7540	0.4509
CITY30	1	2.169393	0.496256	4.3715	0.0001
CITY31	1	-0.096560	0.515139	-0.1874	0.8513
CITY32	1	1.611493	0.439248	3.6688	0.0002
CITY33	1	0.725749	0.487374	1.4891	0.1365
CITY34	1	-0.707942	0.434074	-1.6309	0.1029
CITY35	1	0.257575	0.440609	0.5843	0.5590
CITY36	1	-0.429192	0.438518	-0.9787	0.3277
CITY37	1	0.252237	0.434893	0.5800	0.5619
CITY38	1	-0.601341	0.565238	-1.0639	0.2874
CITY39	1	-1.708433	0.520667	-3.2812	0.0010
CITY40	1	2.010427	0.465682	4.3172	0.0001
CITY41	1	0.699232	0.474764	1.4728	0.1408
CITY42	1	0.509389	0.889797	0.5725	0.5670
CITY43	1	2.755307	0.417149	6.6051	0.0001
CITY44	1	-0.016727	0.436030	-0.0384	0.9694
CITY45	1	-1.043818	0.509058	-2.0505	0.0403
CITY46	1	-0.335901	0.465510	-0.7216	0.4706
CITY47	1	0.378849	0.381296	0.9936	0.3205
CITY48	1	-0.588429	0.453106	-1.2987	0.1941

Mean Blood Lead Explained by Gasoline = 4.32 ug/dl

TEH 0533129

DUP050034399

MODEL: MODEL01		SSE	3854638657	F RATIO	59.83
WEIGHT: WEIGHT		DFE	8542	PROB>F	0.0001
DEP VAR: LEAD		MSE	451257.2	R-SQUARE	0.2853

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T RATIO	PROB>:T:
INTERCEPT	1	6.818219	0.654068	10.4240	0.0001
KID	1	3.022638	0.356609	8.4766	0.0001
TEEN	1	-0.708600	0.188057	-3.7680	0.0002
TEENMALE	1	1.491112	0.534179	2.7914	0.0053
ADLTMALE	1	4.262821	0.497346	8.5711	0.0001
RURAL	1	-0.580746	0.138811	-4.1837	0.0001
MALE	1	0.712947	0.481402	1.4810	0.1386
INCOME1	1	1.220160	0.174595	6.9885	0.0001
INCOME2	1	0.644238	0.116052	5.5513	0.0001
TIME	1	-1.654484	0.241933	-6.8386	0.0001
PBNAT1	1	1.075765	0.151755	7.0888	0.0001
GCITY2	1	-0.00271881	0.001017418	-2.6723	0.0075
GCITY3	1	-0.00122895	0.001274452	-0.9643	0.3349
GCITY4	1	-0.000737195	0.0009490841	-0.7767	0.4373
GCITY5	1	0.004176695	0.0009540849	4.3777	0.0001
GCITY6	1	0.003697653	0.0009543766	3.8744	0.0001
GCITY7	1	0.001928389	0.001285097	1.5006	0.1335
GCITY8	1	-0.00133411	0.001270876	-1.0498	0.2939
GCITY9	1	-0.00242743	0.000928431	-2.6146	0.0090
GCITY10	1	0.0007972192	0.0009894348	0.8057	0.4204
GCITY11	1	-0.0023124	0.0009732846	-2.3759	0.0175
GCITY12	1	-0.00151624	0.0008376225	-1.8102	0.0703
GCITY13	1	-0.00127118	0.0008630052	-1.4730	0.1408
GCITY15	1	0.00438098	0.001179857	3.7131	0.0002
GCITY16	1	0.002505066	0.001376496	1.8199	0.0688
GCITY17	1	-0.00563931	0.001162029	-4.8530	0.0001
GCITY18	1	0.001889655	0.001280859	1.4753	0.1402
GCITY19	1	0.001810591	0.001082134	1.6732	0.0943
GCITY20	1	-0.00287085	0.001144386	-2.5086	0.0121
GCITY21	1	-0.000457816	0.001139614	-0.4017	0.6879
GCITY22	1	-0.00181864	0.0007709432	-2.3590	0.0183
GCITY23	1	-0.00120747	0.0009253598	-1.3049	0.1920
GCITY24	1	0.002228141	0.0008435059	2.6415	0.0083
GCITY25	1	0.0001878955	0.001231184	0.1526	0.8787
GCITY26	1	-0.00388966	0.001251373	-3.1083	0.0019
GCITY27	1	0.007352426	0.000941425	7.8099	0.0001
GCITY28	1	0.00856465	0.001282137	6.6800	0.0001
GCITY29	1	0.0006837457	0.001028941	0.6645	0.5064
GCITY30	1	0.00485551	0.001130752	4.2941	0.0001
GCITY31	1	-0.000287768	0.0009935596	-0.2896	0.7721
GCITY32	1	0.003799185	0.001052068	3.6112	0.0003
GCITY33	1	0.001363788	0.001060147	1.2864	0.1983
GCITY34	1	-0.00148862	0.0008761695	-1.6990	0.0894
GCITY35	1	0.0005020447	0.0009978855	0.5031	0.6149
GCITY36	1	-0.0021054	0.002012392	-1.0462	0.2955
GCITY37	1	0.000637853	0.001284343	0.4965	0.6196
GCITY38	1	-0.00153649	0.001321618	-1.1626	0.2450
GCITY39	1	-0.00378497	0.001083577	-3.4922	0.0005
GCITY40	1	0.003762433	0.0008907528	4.2239	0.0001
GCITY41	1	0.001610906	0.001136658	1.4172	0.1565
GCITY42	1	0.001980073	0.003753412	0.5275	0.5978
GCITY43	1	0.00655331	0.001010486	6.4853	0.0001
GCITY44	1	-0.000102557	0.001135659	-0.0903	0.9280
GCITY45	1	-0.00246974	0.001178021	-2.0965	0.0361
GCITY46	1	-0.000761742	0.001096939	-0.6944	0.4874
GCITY47	1	0.0009568542	0.001067034	0.8967	0.3699
GCITY48	1	-0.00159224	0.001200049	-1.3268	0.1846

Whites, with Time and city by gas interactions

Mean Blood Lead Explained by Gasoline = 4.30 ug/dl

TEH 0533130

DUP050034400

APPENDIX II

Dr. Pirkle's regressions for all races, Blacks, whites, white children, white teenagers, and white adults. Using three different gasoline lead variables.

Table 2

Lead in the Diet (micrograms/day)

Teenage Male

1976	71.1
1977	79.3
1978	95.1
1979	81.7
1980	82.9

No downward trend is present, suggesting that diet is also an unlikely explanation of the decrease in blood lead levels seen over the course of the NHANES II survey.

Lead in gasoline

The only other widespread source of lead exposure (other than occupational) is from leaded gasoline. The amount of lead used in gasoline production across the nation is available from the quarterly refiner's reports to EPA. During a 3-month period, the NHANES II caravans on-the-average sampled 4 different sites in the USA and over a 6-month period they sampled on-the-average 8 sites. Three gas variables were tested to cover both the 3-month and 6-month breakdown of gasoline lead data:

(1) Gas1 = amount of lead used in gasoline for each of the quarters of the year during the NHANES II survey.

(2) Gas2 = amount of lead used in gasoline for the January-June and July-December 6-month periods during the NHANES II survey

(3) Gas3 = amount of lead used in gasoline for the April-September and October-March 6-month periods during the NHANES II survey

The regression procedure included the demographic variables itemized in Appendix A and was performed separately for each of these gas variables. A "gas-squared" term was also permitted to enter each model to account for a curvilinear relation. The regression results by race and selected age groups are given in Appendix A. The amount of downward trend attributable to gasoline lead is tabulated by race and selected age groups in Table 3 and the gas variable with the generally most conservative results (Gas1) is shown in Figure 1. AFTER ACCOUNTING FOR DEMOGRAPHIC VARIABLES, THE GASOLINE LEAD VARIABLE (GAS1, GAS2 OR GAS3) WAS ALWAYS HIGHLY STATISTICALLY SIGNIFICANT (p .0001) AND ALONE COULD ACCOUNT FOR THE DOWNWARD TREND IN LEAD VALUES OVER TIME SEEN IN THE NHANES II SURVEY.

Regression on the Lead in Gasoline Variables

Each of the gas variables is in units of 1000 tons of lead divided by 100 to reduce the magnitude of the variable to approximately that of the 0-1 indicator variables. As with the time regressions, some of the final models contain interaction terms without the corresponding main effects. All of the main effects were reintroduced to these final models and the regression rerun to insure that their omission did not significantly alter the "gas" coefficients or the percent decrease in blood lead levels accounted for by lead in gasoline. The "gas" coefficients changes less than 3.5% and the percent decrease in blood lead levels accounted for by gasoline lead changed less than 1.1% (e.g. 34.4% to 33.3%).

The final models resulted from a manual backward elimination procedure (decribed on page 3) performed separately for each of the three gas variables. In each regression the denominator degrees of freedom (df) is 32. Results are given below for each race and selected age groups of whites. The "gas" variable (Gas1, Gas2, or Gas3) is consistently significant.

Lead in Gasoline Variable: Gas1

Group: Black & White

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	928.2	1	0.0000	0.37584	0.0001500
MALECHILD	327.6	1	0.0000	-0.33918	0.0003500
CHILD	200.4	1	0.0000	0.27565	0.0003800
MALETEEN	128.5	1	0.0000	-0.19898	0.0003100
GAS1	89.6	1	0.0000	1.42693	0.0227163
MALERURL	13.8	1	0.0008	-0.08638	0.0005400
SMALLOUT	5.6	1	0.0247	-0.05091	0.0004700
TEENOUT	4.4	1	0.0434	-0.07768	0.0013639
MALEOUT	4.0	1	0.0541	0.05167	0.0006700
INTERCEPT				1.78655	0.0044702
Overall Model	256.2	9	0.0000		

Group: Black

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	196.3	1	0.0000	0.39318	[illegible]
CHILD	145.3	1	0.0000	0.48829	0.0016415
GAS1	91.2	1	0.0000	0.99997	0.0109703
MALECHILD	68.2	1	0.0000	-0.44610	0.0029167
MALETEEN	18.5	1	0.0002	-0.23137	0.0028991
TEEN	6.4	1	0.0168	0.07328	0.0008400
TEENOUT	3.0	1	0.0919	-0.17989	0.0107213
MALEOUT	2.5	1	0.1288	0.08737	0.0030057
INTERCEPT				2.06451	[illegible]
Overall Model	110.2	8	0.0000		

Group: White

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	674.9	1	0.0000	0.34352	0.0001700
MALECHILD	250.3	1	0.0000	-0.32582	0.0004200
CHILD	126.9	1	0.0000	0.23235	0.0004300
GAS1	104.2	1	0.0000	1.47503	0.0208812
MALETEEN	59.1	1	0.0000	-0.18393	0.0005700
RURAL	22.3	1	0.0000	-0.13970	0.0008800
SMALL	13.3	1	0.0009	-0.10110	0.0007700
TEEN	7.7	1	0.0090	-0.05611	0.0004100
MALEOUT	6.1	1	0.0193	0.04796	0.0003800
INTERCEPT				1.83529	0.0038429
Overall Model	160.6	9	0.0000		

Group: White .5-5 yrs

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	570.9	1	0.0000	0.29737	0.0001500
GAS1	92.3	1	0.0000	1.44410	0.0225929
RURAL	23.8	1	0.0000	-0.14286	0.0008600
SMALL	14.1	1	0.0007	-0.10304	0.0007500
MALEOUT	5.9	1	0.0209	0.05095	0.0004400
INTERCEPT				1.83879	0.0041133
Overall Model	257.0	5	0.0000		

Group: White 6-17 yrs.

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	1174.3	1	0.0000	0.34271	0.0001000
GAS1	114.6	1	0.0000	1.45531	0.0187422
RURAL	20.6	1	0.0001	-0.12087	0.0007100
SMALL	14.9	1	0.0005	-0.09452	0.0006000
INTERCEPT				1.84415	0.0037919
Overall Model	300.8	4	0.0000		

Group: White 18-74 yrs.

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	66.6	1	0.0000	0.15381	0.0003600
GAS1	31.8	1	0.0000	1.40769	0.0622069
RURAL	5.1	1	0.0312	-0.07161	0.0010101
INTERCEPT				1.79792	0.0111279
Overall Model	35.5	3	0.0000		

Lead in Gasoline Variable: GAS2

Group: Blacks & Whites

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	909.4	1	0.0000	0.34076	0.0001300
MALECHILD	377.9	1	0.0000	-0.33764	0.0003000
CHILD	234.0	1	0.0000	0.30608	0.0004000
GAS2	100.6	1	0.0000	0.77418	0.0059587
MALETEEN	95.8	1	0.0000	-0.19386	0.0003900
RURAL	23.8	1	0.0000	-0.14514	0.0008900
MALEOUT	15.1	1	0.0005	0.06695	0.0003000
CHILDRURAL	14.9	1	0.0005	-0.09014	0.0005500
TEEN	5.4	1	0.0273	-0.03967	0.0002900
SMALL	3.8	1	0.0598	-0.05578	0.0008200
SMALLOUT	3.6	1	0.0657	-0.06046	0.0010061
INTERCEPT				1.80786	0.0048407
Overall Model	200.0	11	0.0000		

Group: Black

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	166.0	1	0.0000	0.38893	0.0009100
CHILD	136.7	1	0.0000	0.47271	0.0016347
MALECHILD	56.8	1	0.0000	-0.42610	0.0031954
GAS2SQ	36.2	1	0.0000	0.39912	0.0044039
MALETEEN	21.9	1	0.0001	-0.20361	0.0018978
MALERURL	6.8	1	0.0134	-0.17387	0.0044112
MALEOUT	5.2	1	0.0291	0.15268	0.0044635
SMALLOUT	4.2	1	0.0479	-0.10112	0.0024159
INTERCEPT				2.20442	0.0026534
Overall Model	46.7	8	0.0000		

Group: White

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	748.7	1	0.0000	0.34426	0.0001600
MALECHILD	262.3	1	0.0000	-0.32447	0.0004000
CHILD	129.9	1	0.0000	0.22909	0.0004000
GAS2	83.6	1	0.0000	0.79861	0.0076249
MALETEEN	64.0	1	0.0000	-0.18931	0.0005600

RURAL	19.5	1	0.0001	[illegible]	[illegible]
SMALL	8.7	1	0.0059	[illegible]	[illegible]
TEEN	8.2	1	0.0073	-0.05520	0.0003700
MALEOUT	6.6	1	0.0148	0.04425	0.0002900
INTERCEPT				1.77408	0.0063072
Overall Model	165.4	9	0.0000		

Group: White .5-5 yrs.

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	621.6	1	0.0000	0.29721	0.0001400
GAS2	71.9	1	0.0000	0.77009	0.0082465
RURAL	20.3	1	0.0001	-0.13155	0.0008500
SMALL	9.0	1	0.0052	-0.07902	0.0006900
MALEOUT	5.7	1	0.0230	0.04678	0.0003800
INTERCEPT				1.78925	0.0068279
Overall Model	247.8	5	0.0000		

Group: White 6-17 yrs

Variable	F Stat.	DF	Prob.	Coeff.	Variance
MALE	1343.7	1	0.0000	0.34215	0.0000870
GAS2	77.0	1	0.0000	0.78245	0.0079501
RURAL	16.2	1	0.0003	-0.11078	0.0007600
SMALL	8.6	1	0.0061	-0.07120	0.0005900
INTERCEPT				1.79346	0.0067350
Overall Model	315.5	4	0.0000		

Group: White 18-74 yrs

Variable	F Stat.	DF	Prob.	Coeff.	Variance
GAS2	66.5	1	0.0000	0.84111	0.0106363
MALE	62.3	1	0.0000	0.14837	0.0003500
RURAL	5.7	1	0.0235	-0.07527	0.0010012
INTERCEPT				1.68533	0.0074795
Overall Model	45.5	3	0.0000		

ne variable: GAS3

	F Stat.	DF	Prob.	Coeff.	
	880.3	1	0.0000	0.34937	10
D	336.3	1	0.0000	-0.33742	00
	212.8	1	0.0000	0.30832	0
	102.8	1	0.0000	0.68839	14
	85.3	1	0.0000	-0.18984	.200
	23.2	1	0.0000	-0.14733	9300
L	12.8	1	0.0011	-0.08462	600
	12.7	1	0.0012	-0.09803	500
	5.3	1	0.0279	0.04429	700
	4.3	1	0.0462	-0.03654	100
				1.88479	81
	185.9	10	0.0000		

riance
.0001400
.0003400
.0004500
.0046114
.0004200
.0009300
.0005600
.0007600
0.0003700
0.0003100
0.0038981

F Stat.	DF	Prob.	Coeff.	Variance
204.2	1	0.0000	0.39472	0.0007600
144.3	1	0.0000	0.47893	0.0015895
103.5	1	0.0000	0.49571	0.0023736
64.6	1	0.0000	-0.47215	0.0028230
16.9	1	0.0003	-0.19477	0.0022499
			2.08256	0.0013784
167.6	5	0.0000		

Variance
0.0007600
0.0015895
0.0023736
0.0028230
0.0022499
0.0013784

F Stat.	DF	Prob.	Coeff.	Variance
641.2	1	0.0000	0.34266	0.0001800
238.6	1	0.0000	-0.32357	0.0004400
121.2	1	0.0000	0.23065	[illegible]
101.0	1	0.0000	0.73855	0.0054024
58.1	1	0.0000	-0.18459	[illegible]
20.9	1	0.0001	-0.13[illegible]	[illegible]
14.8	1	0.0005	-0.10004	0.0006800
6.8	1	0.0136	-0.05238	0.0004200
5.4	1	0.0263	0.04778	0.0004200
			1.82802	0.0042439
160.7	9	0.0000		

Variance
0.0001800
0.0004400
[illegible]
4 0.0004200
8 0.0004200
2 0.0042439

APPENDIX III

Dr. Pirkle's expanded regressions on subgroups including region and time.

K

of blood lead on time, GASQ and the demographic covariates is presented below overall (all races) and for population subgroups defined by race, sex and age.

Table 1

Regression of ln (blood lead) on time, gasoline lead and the demographic covariates

Overall

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	15	8679012	578601	271.977	0.0001
ERROR	9598	20418667	2127.388		
C TOTAL	9613	29097679			
ROOT MSE		46.123613	R-SQUARE	0.2983	
DEP MEAN		2.552308	ADJ R-SQ	0.2972	
C.V.		1807.134			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	2.095277	0.056789	36.896	0.0001
TIME	1	-0.00289957	0.0005026863	-5.768	0.0001
GASQ	1	1.014058	0.098840	10.260	0.0001
CHILD	1	0.358810	0.032707	10.971	0.0001
TEEN	1	0.011049	0.016747	0.660	0.5094
RURAL	1	-0.085540	0.009090293	-9.410	0.0001
INC1	1	-0.013582	0.008561066	-1.587	0.1127
RACE1	1	0.080155	0.017059	4.699	0.0001
SOUTH	1	-0.016512	0.009873789	-1.672	0.0945
AS1	1	-0.335250	0.031474	-10.652	0.0001
SEX1	1	0.366128	0.008161028	44.863	0.0001
AS2	1	-0.176068	0.017034	-10.336	0.0001
AR1	1	0.118381	0.044671	2.650	0.0081
AI1	1	-0.167202	0.033486	-4.993	0.0001
AI2	1	-0.085067	0.018105	-4.698	0.0001
RU1	1	0.068556	0.022530	3.043	0.0023

K4

VARIABLE	DF	TOLERANCE	VARIANCE INFLATION
INTERCEP	1	.	0.000000
TIME	1	0.207132	4.827833
GASQ	1	0.202380	4.941189
CHILD	1	0.227473	4.396127
TEEN	1	0.253132	3.950506
RURAL	1	0.714027	1.400507
INC1	1	0.712524	1.403461
RACE1	1	0.416136	2.403063
SOUTH	1	0.495528	2.018050
AS1	1	0.462441	2.162438
SEX1	1	0.723988	1.381238
AS2	1	0.418905	2.387175
AR1	1	0.741449	1.348710
AI1	1	0.340399	2.937731
AI2	1	0.293672	3.405159
RU1	1	0.436398	2.291485

Blacks

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	10	970585	97058.458	60.259	0.0001
ERROR	1260	2029465	1610.686		
C TOTAL	1270	3000049			
ROOT MSE		40.133358	R-SQUARE	0.3235	
DEP MEAN		2.680228	ADJ R-SQ	0.3182	
C.V.		1497.386			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	2.526215	0.103983	24.295	0.0001
TIME	1	-0.00500626	0.0009984329	-5.014	0.0001
GASQ	1	0.353966	0.186508	1.898	0.0579
CHILD	1	0.526338	0.056123	9.378	0.0001
TEEN	1	0.054550	0.028944	1.885	0.0597
INC1	1	-0.030271	0.020077	-1.508	0.1319
WINTER	1	-0.116598	0.018725	-6.227	0.0001
AS1	1	-0.443217	0.070593	-6.278	0.0001
SEX1	1	0.418723	0.022684	18.459	0.0001
AS2	1	-0.250017	0.041580	-6.013	0.0001
AI1	1	-0.129830	0.072786	-1.784	0.0747

TEH 0533140

K

VARIABLE	DF	TOLERANCE	VARIANCE INFLATION
INTERCEP	1	.	0.000000
TIME	1	0.306376	3.263960
GASQ	1	0.328057	3.048253
CHILD	1	0.380611	2.627353
TEEN	1	0.495075	2.019895
INC1	1	0.853977	1.170992
WINTER	1	0.929210	1.076183
AS1	1	0.438790	2.278996
SEX1	1	0.636460	1.571190
AS2	1	0.403807	2.476432
AI1	1	0.621781	1.608284

Whites

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	12	7343074	611923	281.731	0.0001
ERROR	8115	17625888	2172.013		
C TOTAL	8127	24968962			
ROOT MSE		46.604863	R-SQUARE	0.2941	
DEP MEAN		2.534574	ADJ R-SQ	0.2930	
C.V.		1838.765			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	1.992910	0.061852	32.221	0.0001
TIME	1	-0.0021311	0.0005485945	-3.885	0.0001
GASQ	1	1.226663	0.107695	11.390	0.0001
CHILD	1	0.336005	0.036347	9.244	0.0001
TEEN	1	0.004706979	0.019437	0.242	0.8087
RURAL	1	-0.095105	0.009430613	-10.085	0.0001
INC1	1	-0.017754	0.009301633	-1.909	0.0563
SOUTH	1	-0.010784	0.010659	-1.012	0.3117
AS1	1	-0.324540	0.035340	-9.183	0.0001
SEX1	1	0.360146	0.008807009	40.893	0.0001
AS2	1	-0.174523	0.018691	-9.337	0.0001
AI1	1	-0.156417	0.037990	-4.117	0.0001
AI2	1	-0.087937	0.020718	-4.244	0.0001

K

VARIABLE	DF	TOLERANCE	VARIANCE INFLATION
INTERCEP	1	.	0.000000
TIME	1	0.207085	4.828940
GASQ	1	0.206078	4.852540
CHILD	1	0.232822	4.295129
TEEN	1	0.226672	4.411655
RURAL	1	0.831405	1.202783
INC1	1	0.746841	1.338973
SOUTH	1	0.501725	1.993125
AS1	1	0.469661	2.129194
SEX1	1	0.735047	1.360458
AS2	1	0.421654	2.371610
AI1	1	0.306019	3.267767
AI2	1	0.255298	3.916990

White males

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	8	1894294	236787	115.347	0.0001
ERROR	4029	8270834	2052.825		
C TOTAL	4037	10165128			
ROOT MSE		45.308117	R-SQUARE	0.1864	
DEP MEAN		2.689992	ADJ R-SQ	0.1847	
C.V.		1684.322			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	2.460820	0.083823	29.357	0.0001
TIME	1	-0.00337228	0.0007075701	-4.766	0.0001
GASQ	1	0.971793	0.143880	6.754	0.0001
CHILD	1	-0.029760	0.042495	-0.700	0.4838
TEEN	1	-0.169140	0.025128	-6.731	0.0001
INC1	1	-0.046217	0.013411	-3.446	0.0006
SOUTH	1	-0.042896	0.013829	-3.102	0.0019
AI1	1	-0.101171	0.051547	-1.963	0.0498
AI2	1	-0.086459	0.029153	-2.966	0.0030

VARIABLE	DF	TOLERANCE	VARIANCE INFLATION
INTERCEP	1	.	0.000000
TIME	1	0.239792	4.170285
GASQ	1	0.225153	4.441424
CHILD	1	0.315469	3.169881
TEEN	1	0.252792	3.955827
INC1	1	0.739640	1.352010
SOUTH	1	0.577555	1.731438
AI1	1	0.310630	3.219268
AI2	1	0.232440	4.302188

K

White females

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	9	1940211	215579	93.998	0.0001
ERROR	4080	9357293	2293.454		
C TOTAL	4089	11297504			
ROOT MSE		47.890022	R-SQUARE	0.1717	
DEP MEAN		2.386616	ADJ R-SQ	0.1699	
C.V.		2006.608			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	1.967295	0.089469	21.989	0.0001
TIME	1	-0.00222252	0.0007992199	-2.781	0.0054
GASQ	1	1.288704	0.156251	8.248	0.0001
CHILD	1	0.372557	0.046517	8.009	0.0001
TEEN	1	0.004172502	0.024389	0.171	0.8642
RURAL	1	-0.119651	0.013610	-8.791	0.0001
INC1	1	0.008169898	0.012932	0.632	0.5276
SOUTH	1	-0.00521605	0.015500	-0.337	0.7365
AI1	1	-0.211954	0.056015	-3.784	0.0002
AI2	1	-0.089518	0.029476	-3.037	0.0024

VARIABLE	DF	TOLERANCE	VARIANCE INFLATION
INTERCEP	1	.	0.000000
TIME	1	0.202290	4.943390
GASQ	1	0.200592	4.985256
CHILD	1	0.306560	3.262004
TEEN	1	0.308914	3.237150
RURAL	1	0.824781	1.212443
INC1	1	0.761369	1.313424
SOUTH	1	0.489178	2.044244
AI1	1	0.300735	3.325188
AI2	1	0.280842	3.560720

Whites .5 - 5 years

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	5	196919	39383.900	90.845	0.0001
ERROR	1826	791622	433.528		
C TOTAL	1831	988542			
ROOT MSE		20.821338	R-SQUARE	0.1992	
DEP MEAN		2.636024	ADJ R-SQ	0.1970	
C.V.		789.8766			

TEH 0533143

K

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	2.432027	0.128205	18.970	0.0001
TIME	1	-0.00470414	0.001108857	-4.242	0.0001
GASQ	1	0.966805	0.218260	4.430	0.0001
INC1	1	-0.166021	0.016629	-9.984	0.0001
SOUTH	1	-0.022522	0.020711	-1.087	0.2770
SEX1	1	0.033558	0.015299	2.193	0.0284

VARIABLE	DF	TOLERANCE	VARIANCE INFLATION
INTERCEP	1	.	0.000000
TIME	1	0.211230	4.734173
GASQ	1	0.195514	5.114714
INC1	1	0.979491	1.020938
SOUTH	1	0.560589	1.783837
SEX1	1	0.998565	1.001437

Whites 6-17 years

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	4	856885	214221	86.872	0.0001
ERROR	1371	3380787	2465.928		
C TOTAL	1375	4237672			
	ROOT MSE	49.658110	R-SQUARE	0.2022	
	DEP MEAN	2.428723	ADJ R-SQ	0.1999	
	C.V.	2044.618			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	2.091095	0.100643	20.777	0.0001
TIME	1	-0.00431879	0.0009343327	-4.622	0.0001
GASQ	1	0.939581	0.185208	5.073	0.0001
SEX1	1	0.186173	0.017582	10.589	0.0001
INC1	1	-0.095289	0.019846	-4.801	0.0001

VARIABLE	DF	TOLERANCE	VARIANCE INFLATION
INTERCEP	1	.	0.000000
TIME	1	0.388770	2.572214
GASQ	1	0.388712	2.572598
SEX1	1	0.993820	1.006218
INC1	1	0.985447	1.014768

K

Whites 18-74 years

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	5	5831485	1166297	423.261	0.0001
ERROR	5063	13951108	2755.502		
C TOTAL	5068	19782593			
ROOT MSE		52.492878	R-SQUARE	0.2948	
DEP MEAN		2.558390	ADJ R-SQ	0.2941	
C.V.		2051.794			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0	PROB > |T|
INTERCEP	1	1.986593	0.079831	24.885	0.0001
TIME	1	-0.00194133	0.0007102792	-2.733	0.0063
GASQ	1	1.210007	0.139453	8.677	0.0001
SEX1	1	0.359713	0.009758612	36.861	0.0001
RURAL	1	-0.091780	0.012077	-7.599	0.0001
SOUTH	1	-0.020356	0.013786	-1.477	0.1399

VARIABLE	DF	TOLERANCE	VARIANCE INFLATION
INTERCEP	1	.	0.000000
TIME	1	0.205217	4.872901
GASQ	1	0.202679	4.933917
SEX1	1	0.999462	1.000538
RURAL	1	0.831929	1.202026
SOUTH	1	0.499941	2.000236

F statistics can be obtained by squaring the T for H_o: parameter = 0. The tolerances on the time and GASQ variables indicate that the coefficents estimates should be reasonably stable. Percent drop calculations were done as previously described except time was included in the calculation so the "adjusted" intercept includes the coefficient of time multiplied by the mean value of time over the survey. Results of the percent drop calculations are given in Table 2:

KID

TABLE 2*

Decrease in blood lead levels over the period of NHANES II from regression analysis which simultaneously includes time, GASQ and the demographic covariates in the model

Blood Lead Levels (ug/dl)

Group	Beginning of The Survey	End of The Survey	Difference	Percent Difference
Overall (all races)	14.20	10.53	3.67	25.9
Blacks	15.26	13.75	1.51	9.9
Whites	14.18	9.87	4.31	30.4
White:males	16.10	12.08	4.01	24.9
females	12.36	8.45	3.91	31.6
.5-5 years	15.18	11.41	3.77	24.8
6-17 years	12.33	9.34	2.98	24.2
18-74 years	14.51	10.15	4.35	30.0

*The results in this table assume that the coefficient on the time variable is completely unrelated to gasoline lead exposure, which is incorrect. Thus, the decreases shown in the table are underestimates of the reduction in blood lead levels which can be accounted for by gasoline lead exposure.

APPENDIX IV

Dr. Pirkle's regressions using all demographic variables and interactions (144 variables) for several different subgroups.

GROUP: BLACK

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB.
MODEL	99	1262926	12756.831	8.180	0.0001
ERROR	1236	1927611	1559.556		
C TOTAL	1335	3190537			
ROOT MSE		39.491211	R-SQUARE	0.3958	
DEP MEAN		2.687574	ADJ R-SQ	0.3474	
C.V.		1469.4			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROBABILITY
INTERCEP	1	1.569498	0.299517	5.240	0.0001
GAS1	1	1.157311	0.213861	5.412	0.0001
MALE	1	0.379161	0.094099	4.029	0.0001
SMALL	1	0.217756	0.143277	1.520	0.1288
RURAL	1	-0.198785	0.140849	-1.411	0.1584
MALESMAL	1	-0.026104	0.054564	-0.478	0.6324
MALERURL	1	-0.023820	0.075721	-0.315	0.7531
MALECHILD	1	-0.529322	0.161320	-3.281	0.0011
MALETEEN	1	-0.278784	0.098586	-2.828	0.0048
CENTER	1	0.0003791363	0.111755	0.003	0.9973
TEENRURL	1	-0.107607	0.082727	-1.301	0.1936
MALECEN	1	-0.064782	0.047760	-1.356	0.1752
SMALLCEN	1	-0.010155	0.062648	-0.162	0.8713
CHILD	1	0.488679	0.184889	2.643	0.0083
TEEN	1	0.093321	0.111090	0.840	0.4010
CHILDSMAL	1	-0.069532	0.179626	-0.387	0.6988
TEENSMAL	1	-0.132329	0.107858	-1.227	0.2201
CHILDRURAL	1	-0.058882	0.138478	-0.425	0.6708
CHILDCEN	1	0.015876	0.094009	0.169	0.8659
TEENCEN	1	-0.034681	0.055393	-0.626	0.5314
INCOME1	1	-0.138624	0.129920	-1.067	0.2862
INCOME2	1	-0.210151	0.113685	-1.849	0.0648
MALEINC1	1	0.028953	0.065161	0.444	0.6569
MALEINC2	1	0.064329	0.055027	1.169	0.2426
[illegible]	1	-0.015956	0.172539	-0.092	0.9263
CHILDINC2	1	-0.010650	0.158268	-0.067	0.9462
TEENINC1	1	0.241499	0.100963	2.392	0.0169
[illegible]	1	0.066690	0.082979	0.804	0.4217
SMALLIN1	1	-0.051935	0.075758	-0.686	0.4931
SMALLIN2	1	-0.121242	0.064341	-1.884	0.0598
RURALIN1	1	-0.036375	0.108485	-0.335	0.7375
RURALIN2	1	-0.024201	0.096656	-0.250	0.8023
INC1CEN	1	0.026767	0.069133	0.387	0.6987
INC2CEN	1	0.006628698	0.060839	0.109	0.9133
NORTHEST	1	0.476641	0.289759	1.645	0.1002
MIDWEST	1	0.622332	0.300421	2.072	0.0385
SOUTH	1	0.395211	0.280618	1.408	0.1593

TEH 0533148

DUP050034418

WINTER	1	0.426346	0.276423	1.542	0.1232
SPRING	1	0.495277	0.259124	1.911	0.0562
SUMMER	1	-0.106632	0.117593	-0.907	0.3647
MALENORT	1	0.043927	0.084584	0.519	0.6036
CENTNORT	1	0.134453	0.121699	1.105	0.2695
CHILDNORT	1	0.107879	0.155403	0.694	0.4877
TEENNORT	1	0.078327	0.092038	0.851	0.3949
SMALNORT	1	-0.301621	0.149631	-2.016	0.0440
INC1NORT	1	0.145367	0.118824	1.223	0.2214
INC2NORT	1	0.212100	0.105624	2.008	0.0449
MIDWSPRI	1	-0.354389	0.251730	-1.408	0.1594
MIDWSUMM	1	-0.203159	0.145928	-1.392	0.1641
MALEMIDW	1	-0.059755	0.089298	-0.669	0.5035
CENTMIDW	1	0.134658	0.123409	1.091	0.2754
CHILDMIDW	1	0.079546	0.152442	0.522	0.6019
TEENMIDW	1	0.069377	0.103136	0.673	0.5013
SMALMIDW	1	-0.530841	0.198522	-2.674	0.0076
RURLMIDW	1	0.176901	0.166526	1.062	0.2883
INC1MIDW	1	0.143924	0.126462	1.138	0.2553
INC2MIDW	1	0.117009	0.112925	1.036	0.3003
SOUTWINT	1	-0.627481	0.246508	-2.545	0.0110
SOUTSPRI	1	-0.651255	0.244963	-2.659	0.0079
MALESOUT	1	0.0002081519	0.070400	0.003	0.9976
CENTSOUT	1	0.080915	0.090716	0.892	0.3726
CHILDSOUT	1	-0.00904985	0.115524	-0.078	0.9376
TEENSOUT	1	-0.092364	0.076602	-1.206	0.2281
SMALSOUT	1	-0.051022	0.119590	-0.427	0.6697
RURLSOUT	1	0.264165	0.121639	2.172	0.0301
INC1SOUT	1	0.195572	0.097286	2.010	0.0446
INC2SOUT	1	0.260521	0.086594	3.009	0.0027
MALEWINT	1	0.138065	0.062492	2.209	0.0273
CENTWINT	1	-0.031127	0.094591	-0.329	0.7422
CHILDWINT	1	-0.072653	0.113395	-0.641	0.5218
TEENWINT	1	-0.040081	0.068923	-0.582	0.5610
SMALWINT	1	-0.028598	0.101737	-0.281	0.7787
RURLWINT	1	-0.00370968	0.097246	-0.038	0.9696
INC1WINT	1	0.086760	0.089421	0.970	0.3321
INC2WINT	1	0.188958	0.081205	2.327	0.0201
MALESPRI	1	0.035246	0.054763	0.644	0.5199
CENTSPRI	1	0.016754	0.087286	0.192	0.8478
CHILDSPRI	1	-0.023310	0.112193	-0.208	0.8354
TEENSPRI	1	-0.00654703	0.063000	-0.104	[illegible]
SMALSPRI	1	-0.021462	0.115539	-0.186	[illegible]
INC1SPRI	1	-0.032211	0.081189	-0.397	[illegible]
INC2SPRI	1	0.079781	0.070839	1.126	[illegible]
MALESUMM	1	0.138250	0.074115	1.865	[illegible]
CENTSUMM	1	-0.190023	0.112505	-1.689	[illegible]
CHILDSUMM	1	0.035721	0.124649	0.267	0.7745
TEENSUMM	1	-0.073693	0.088355	-0.834	0.4044
SMALSUMM	1	0.414412	0.134850	3.073	0.0022
INC1SUMM	1	0.130787	0.109373	1.196	0.2320
INC2SUMM	1	0.206595	0.089303	2.313	0.0209

TEH 0533149

DUP050034419

NORTSPR1	1	-0.964632	[illegible]	-3.535	0.0004
MA_CH_SM	1	0.031669	[illegible]	0.223	0.8234
MA_TE_SM	1	0.103594	[illegible]	1.184	0.2365
MA_CH_N1	1	0.148016	[illegible]	0.765	0.4446
MA_CH_N2	1	0.024598	[illegible]	0.138	0.8902
MA_TE_N1	1	-0.081137	[illegible]	-0.625	0.5323
MA_TE_N2	1	-0.041276	[illegible]	-0.375	0.7077
KI_SM_N1	1	0.049462	[illegible]	0.245	0.8064
KI_SM_N2	1	0.024001	[illegible]	0.131	0.8954
TE_SM_N1	1	-0.064581	[illegible]	-0.509	0.6108
TE_SM_N2	1	0.016651	[illegible]	0.149	0.8816

WINTER	1	0.072250	0.065318	1.106	0.2687
SPRING	1	-0.022537	0.033106	-0.681	0.4960
SUMMER	1	0.026203	0.075889	0.345	0.7299
NORTSUMM	1	-0.206051	0.069557	-2.962	0.0031
MALENORT	1	0.029474	0.025286	1.166	0.2438
CENTNORT	1	-0.112028	0.036796	-3.045	0.0023
CHILDNORT	1	-0.030271	0.057640	-0.525	0.5995
TEENNORT	1	-0.081969	0.031406	-2.610	0.0091
SMALNORT	1	0.017312	0.057687	0.300	0.7641
RURLNORT	1	-0.00649545	0.056696	-0.115	0.9088
INC1NORT	1	-0.102480	0.048004	-2.135	0.0328
INC2NORT	1	-0.00344828	0.027095	-0.127	0.8987
MIDWSPRI	1	-0.077494	0.067695	-1.145	0.2523
MIDWSUMM	1	-0.206893	0.071882	-2.878	0.0040
MALEMIDW	1	0.019826	0.024756	0.801	0.4232
CENTMIDW	1	0.009510813	0.037556	0.253	0.8001
CHILDMIDW	1	-0.089157	0.056432	-1.580	0.1142
TEENMIDW	1	-0.131807	0.030828	-4.276	0.0001
SMALMIDW	1	-0.072570	0.056481	-1.285	0.1989
RURLMIDW	1	0.040799	0.056452	0.723	0.4699
INC1MIDW	1	-0.069253	0.043283	-1.600	0.1096
INC2MIDW	1	0.001081804	0.026716	0.040	0.9677
SOUTWINT	1	-0.050861	0.064906	-0.784	0.4333
SOUTSPRI	1	-0.134995	0.066858	-2.019	0.0435
MALESOUT	1	0.043935	0.022379	1.963	0.0497
CENTSOUT	1	0.010368	0.033579	0.309	0.7575
CHILDSOUT	1	0.015354	0.051574	0.298	0.7659
TEENSOUT	1	-0.119736	0.027642	-4.332	0.0001
SMALSOUT	1	0.046821	0.041455	1.129	0.2587
RURLSOUT	1	0.038014	0.041971	0.906	0.3651
INC1SOUT	1	-0.049147	0.041114	-1.195	0.2320
INC2SOUT	1	0.003978589	0.023820	0.167	0.8674
MALEWINT	1	0.011383	0.026336	0.432	0.6656
CENTWINT	1	-0.123214	0.044191	-2.788	0.0053
CHILDWINT	1	-0.032429	0.059499	-0.545	0.5857
TEENWINT	1	-0.047732	0.032500	-1.469	0.1420
SMALWINT	1	-0.038583	0.050880	-0.758	0.4483
RURLWINT	1	-0.071203	0.047211	-1.508	0.1315
INC1WINT	1	-0.034122	0.044513	-0.767	0.4434
INC2WINT	1	0.008974754	0.028311	0.317	[illegible]
MALESPRI	1	0.016736	0.023487	0.713	[illegible]
CENTSPRI	1	-0.082546	0.035383	-2.333	0.0197
CHILDSPRI	1	-0.00442761	0.057499	-0.077	[illegible]
TEENSPRI	1	-0.042029	0.029295	-1.435	[illegible]
SMALSPRI	1	0.108667	0.062940	1.727	0.0843
RURLSPRI	1	0.062518	0.062415	1.002	0.3165
INC1SPRI	1	-0.018978	0.043885	-0.432	0.6654
INC2SPRI	1	0.012914	0.025294	0.511	0.6097
MALESUMM	1	-0.00626316	0.023101	-0.271	0.7863
CENTSUMM	1	-0.070491	0.035070	-2.010	0.0445
CHILDSUMM	1	0.011562	0.058181	0.199	0.8425
TEENSUMM	1	-0.00958338	0.028255	-0.339	0.7345

[illegible] WHITE

[illegible]IABLE: LEAD

[illegible]	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB.
	108	8272981	76601.678	36.622	0.0001
	8260	17277357	2091.690		
[illegible]TAL	8368	25550339			
ROOT MSE		45.734995	R-SQUARE	0.3238	
DEP MEAN		2.538587	ADJ R-SQ	0.3149	
C.V.		1801.592			

[illegible]IABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROBABILITY
[illegible]CEP	1	1.861071	0.068888	27.016	0.0001
[illegible]	1	1.415455	0.067626	20.931	0.0001
[illegible]	1	0.255598	0.031371	8.147	0.0001
[illegible]LL	1	-0.140986	0.057663	-2.445	0.0145
[illegible]AL	1	-0.203938	0.055650	-3.665	0.0002
[illegible]ALESMAL	1	0.050159	0.022696	2.210	0.0271
MALERURL	1	0.116655	0.024195	4.821	0.0001
MALECHILD	1	-0.194754	0.079448	-2.451	0.0143
MALETEEN	1	-0.087073	0.039284	-2.217	0.0267
CENTER	1	0.083449	0.045800	1.822	0.0685
TEENRURL	1	0.084469	0.041362	2.042	0.0412
MALECEN	1	-0.017072	0.019437	-0.878	0.3798
SMALLCEN	1	0.021446	0.023737	0.903	0.3663
CHILD	1	0.138525	0.080688	1.717	0.0861
TEEN	1	-0.025281	0.042920	-0.589	0.5559
CHILDSMAL	1	0.041534	0.082256	0.505	0.6136
TEENSMAL	1	-0.044735	0.040215	-1.112	0.2660
CHILDRURAL	1	0.080281	0.080033	1.003	0.3158
CHILDCEN	1	0.045143	0.047220	0.956	0.3391
TEENCEN	1	0.089890	0.025040	3.590	0.0003
INCOME1	1	-0.040688	0.057275	-0.710	0.4775
INCOME2	1	-0.014213	0.033287	-0.427	0.6694
MALEINC1	1	-0.0059357	0.030045	-0.198	0.8434
MALEINC2	1	0.057814	0.018310	3.157	0.0016
CHILDINC1	1	0.25374[illegible]	0.163493	1.552	0.1207
CHILDINC2	1	0.15405[illegible]	0.084273	1.828	0.0675
TEENINC1	1	-0.089260	0.115670	-0.772	0.4403
TEENINC2	1	0.013903	0.043925	0.317	0.7516
SMALLIN1	1	0.012843	0.040675	0.316	0.7522
SMALLIN2	1	-0.035603	0.024223	-1.470	0.1417
RURALIN1	1	0.154589	0.045325	3.411	0.0007
RURALIN2	1	0.039049	0.025746	1.517	0.1294
INC1CEN	1	0.132514	0.035631	3.719	0.0002
INC2CEN	1	0.042917	0.020733	2.070	0.0385
NORTHEST	1	0.096080	0.062628	1.534	0.1250
MIDWEST	1	0.084797	0.067568	1.255	0.2095
SOUTH	1	-0.018933	0.066412	-0.285	0.7756

SMALSUMM	1	0.173757	0.032145	5.[illegible]	[illegible]
RURLSUMM	1	0.059308	0.031926	1.[illegible]	[illegible]
INC1SUMM	1	0.129893	0.047648	2.[illegible]	[illegible]
INC2SUMM	1	0.0002637513	0.024663	0.[illegible]	[illegible]
MA_CH_SM	1	-0.096733	0.092325	-1.[illegible]	0.294[illegible]
MA_CH_RU	1	-0.181780	0.092464	-1[illegible]	0.0493
MA_TE_SM	1	-0.023007	0.047173	-[illegible]	0.625[illegible]
MA_TE_RU	1	-0.150470	0.047573	-3.[illegible]	0.0016
MA_CH_N1	1	0.0002409143	0.134585	[illegible]	0.9986
MA_CH_N2	1	-0.076664	0.072863	-1.[illegible]	0.2928
MA_TE_N1	1	0.151758	0.079634	1.[illegible]	0.0567
MA_TE_N2	1	-0.086023	0.038365	-2.[illegible]	0.0250
KI_SM_N1	1	-0.029524	0.168984	-0.1[illegible]	0.8613
KI_SM_N2	1	-0.035226	0.096984	-0.36[illegible]	0.7165
KI_RU_N1	1	-0.106785	0.176376	-0.605	0.5449
KI_RU_N2	1	-0.079677	0.096792	-0.823	0.4104
TE_SM_N1	1	0.225812	0.117036	1.9[illegible]	0.0537
TE_SM_N2	1	0.097939	0.049672	1.97[illegible]	0.0487
TE_RU_N1	1	0.190020	0.117180	1.62[illegible]	0.1049
TE_RU_N2	1	0.066925	0.049796	1.344	0.1790

TEH 0533153

DUP050034423

[illegible]UP: WHITE .5-5 Y[illegible]

[illegible]EP VARIABLE: LEAD

SOURCE	DF	S[illegible] SQ[illegible]	MEAN SQUARE	F VALUE	PROB.
MODEL	66	[illegible]	3572.288	9.522	0.0001
ERROR	1808	[illegible]	406.665		
C TOTAL	1874	[illegible]			
ROOT MSE		20.[illegible]	R-SQUARE	0.2579	
DEP MEAN		2.[illegible]	ADJ R-SQ	0.2309	
C.V.		76[illegible]			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROBABILITY
INTERCEP	1	2.150[illegible]	0.284505	7.558	0.0001
GAS1	1	1.74[illegible]	0.136878	12.714	0.0001
MALE	1	0.0[illegible]411	0.059911	0.474	0.6354
SMALL	1	-0.21[illegible]	0.152564	-1.388	0.1652
RURAL	1	-0.417819	0.140822	-2.967	0.0030
MALESMAL	1	-0.080866	0.042942	-1.883	0.0598
MALERURL	1	-0.044241	0.044047	-1.004	0.3153
CENTER	1	0.073248	0.118362	0.619	0.5361
MALECEN	1	0.058127	0.041357	1.405	0.1600
SMALLCEN	1	0.015919	0.052757	0.302	0.7629
INCOME1	1	0.349739	0.131850	2.653	0.0081
INCOME2	1	0.217058	0.063971	3.393	0.0007
MALEINC1	1	-0.043733	0.059027	-0.741	0.4589
MALEINC2	1	-0.027133	0.032084	-0.846	0.3978
SMALLIN1	1	0.00544908	0.085946	0.063	0.9495
SMALLIN2	1	-0.088971	0.046066	-1.931	0.0536
RURALIN1	1	-0.027566	0.098539	-0.280	0.7797
RURALIN2	1	-0.065513	0.046904	-1.397	0.1627
INC1CEN	1	-0.013382	0.076934	-0.174	0.8619
INC2CEN	1	0.059840	0.044589	1.342	0.1798
NORTHEST	1	-0.264813	0.279616	-0.947	0.3437
MIDWEST	1	-0.317344	0.290673	-1.092	0.2751
SOUTH	1	-0.323845	0.279945	-1.157	0.2475
WINTER	1	-0.136515	0.281380	-0.485	0.6276
SPRIN[illegible]	1	-0.068868	0.086824	-0.793	0.4278
SUMMER	1	-0.180035	0.247894	-0.726	0.4678
NORTSU[illegible]	1	0.082880	0.247523	0.335	0.7378
MALENO[illegible]	1	0.056975	0.049865	1.1[illegible]3	0.253[illegible]
CENTNORT	1	-0.104848	0.077734	-1.[illegible]	0.177[illegible]
SMALNORT	1	0.159340	0.165176	0.9[illegible]5	0.33[illegible]
RURLNORT	1	0.259615	0.160227	1.620	0.1053
INC1NORT	1	-0.072784	0.101995	-0.714	0.4756
INC2NORT	1	-0.037284	0.053464	-0.697	0.4857
MIDWSPRI	1	0.079125	0.237824	0.333	0.7394
MIDWSUMM	1	0.004819256	0.245430	0.020	0.9843
MALEMIDW	1	-0.039178	0.048723	-0.804	0.4214
CENTMIDW	1	-0.0053324	0.081316	-0.066	0.9477

SMALMIDW	1	0.201478	0.162814	1.237	0.2161
RURLMIDW	1	0.264298	0.159002	1.662	0.0966
INC1MIDW	1	-0.031402	0.108717	-0.289	0.7727
INC2MIDW	1	-0.023783	0.051257	-0.464	0.6427
SOUTWINT	1	-0.067052	0.248405	-0.270	0.7872
SOUTSPRI	1	-0.061024	0.248232	-0.246	0.8058
MALESOUT	1	0.026148	0.044670	0.585	0.5584
CENTSOUT	1	-0.099703	0.073716	-1.353	0.1764
SMALSOUT	1	0.308536	0.130419	2.366	0.0181
RURLSOUT	1	0.426829	0.129233	3.303	0.0010
INC1SOUT	1	-0.030437	0.093703	-0.325	0.7454
INC2SOUT	1	-0.036069	0.048103	-0.750	0.4535
MALEWINT	1	0.056186	0.051362	1.094	0.2741
CENTWINT	1	-0.214878	0.109397	-1.964	0.0497
SMALWINT	1	0.085560	0.144593	0.592	0.5541
RURLWINT	1	0.065455	0.133578	0.490	0.6242
INC1WINT	1	-0.034858	0.105963	-0.329	0.7422
INC2WINT	1	-0.042607	0.055390	-0.769	0.4419
MALESPRI	1	0.071178	0.050382	1.413	0.1579
CENTSPRI	1	-0.034542	0.089841	-0.384	0.7007
SMALSPRI	1	-0.035072	0.239052	-0.147	0.8834
RURLSPRI	1	0.095607	0.236999	0.403	0.6867
INC1SPRI	1	-0.088370	0.104561	-0.845	0.3981
INC2SPRI	1	-0.074288	0.054830	-1.355	0.1756
MALESUMM	1	0.054334	0.051224	1.061	0.2890
CENTSUMM	1	0.021747	0.084013	0.259	0.7958
SMALSUMM	1	0.065194	0.089326	0.730	0.4656
RURLSUMM	1	0.143107	0.081462	1.757	0.0791
INC1SUMM	1	-0.092132	0.113091	-0.815	0.4154
INC2SUMM	1	-0.010860	0.055894	-0.194	0.8460

GROUP: WHITE 6-17 YRS

DEP VARIABLE: LEAD

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB.
MODEL	62	1395921	22514.852	10.234	0.0001
ERROR	1361	2994174	2199.981		
C TOTAL	1423	4390095			
ROOT MSE		46.903955	R-SQUARE	0.3180	
DEP MEAN		2.431224	ADJ R-SQ	0.2869	
C.V.		1929.232			

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROBABILITY
INTERCEP	1	1.713816	0.183622	9.333	0.0001
GAS1	1	1.466824	0.153307	9.568	0.0001
MALE	1	0.179940	0.064764	2.778	0.0055
SMALL	1	-0.355259	0.153702	-2.311	0.0210
RURAL	1	-0.252923	0.149201	-1.695	0.0903
MALESMAL	1	-0.023406	0.047833	-0.489	0.6247
MALERURL	1	-0.044657	0.048512	-0.921	0.3575
CENTER	1	0.053860	0.115630	0.466	0.6414
MALECEN	1	-0.00307653	0.046380	-0.066	0.9471
SMALLCEN	1	0.097307	0.061253	1.589	0.1124
INCOME1	1	-0.056082	0.123554	-0.454	0.6500
INCOME2	1	-0.00561208	0.070181	-0.080	0.9363
MALEINC1	1	0.169580	0.077316	2.193	0.0285
MALEINC2	1	-0.022515	0.035572	-0.633	0.5269
SMALLIN1	1	0.140008	0.125212	1.118	0.2637
SMALLIN2	1	0.094677	0.051918	1.824	0.0684
RURALIN1	1	0.056783	0.131841	0.431	0.6668
RURALIN2	1	0.144304	0.051304	2.813	0.0050
INC2CEN	1	0.099926	0.048187	2.074	0.0383
NORTHEST	1	0.041213	0.172901	0.238	0.8116
MIDWEST	1	-0.022143	0.183430	-0.121	0.9039
SOUTH	1	-0.00631478	0.178939	-0.035	0.9719
WINTER	1	0.228072	0.177302	1.286	0.1985
SPRING	1	0.044945	0.071172	0.632	0.5278
SUMMER	1	0.359034	0.186216	1.928	0.05[illegible]
NORTSUMM	1	-0.437736	0.176883	-2.475	0.0[illegible]
MALENORT	1	0.011491	0.056964	0.202	0.8[illegible]
CENTNORT	1	-0.027289	0.089486	-0.305	[illegible]
SMALNORT	1	0.225095	0.157869	1.426	0.154[illegible]
RURLNORT	1	0.134203	0.154874	0.867	0.3864
INC2NORT	1	0.050902	0.059107	0.861	0.3893
MIDWSPRI	1	-0.335308	0.169139	-1.982	0.0476
MIDWSUMM	1	-0.524376	0.179830	-2.916	0.0036
MALEMIDW	1	-0.027479	0.055599	-0.494	0.6212
CENTMIDW	1	0.283439	0.089030	3.184	0.0015
SMALMIDW	1	0.218427	0.153896	1.419	0.156[illegible]
RURLMIDW	1	0.319026	0.153089	2.084	0.037[illegible]

TEH 0533156

DUP050034426

INC2MIDW	1	-0.031541	[illegible]	[illegible]	0.5873
SOUTWINT	1	-0.327255	[illegible]	[illegible]	0.0588
SOUTSPRI	1	-0.466160	[illegible]	[illegible]	0.0086
MALESOUT	1	-0.00154948	[illegible]	[illegible]	0.9754
CENTSOUT	1	0.053009	[illegible]	[illegible]	0.5035
SMALSOUT	1	0.187229	[illegible]	1.346	0.1786
RURLSOUT	1	0.265537	[illegible]	1.953	0.0510
INC1SOUT	1	0.213808	[illegible]	2.101	0.0359
INC2SOUT	1	-0.040070	[illegible]	-0.763	0.4455
MALEWINT	1	-0.032774	[illegible]	-0.553	0.5801
CENTWINT	1	-0.077359	[illegible]	-0.692	0.4893
SMALWINT	1	0.069341	[illegible]	0.469	0.6394
RURLWINT	1	-0.051038	[illegible]	-0.362	0.7174
INC1WINT	1	-0.136775	[illegible]	-1.434	0.1519
INC2WINT	1	-0.023983	0.062373	-0.386	0.6997
MALESPRI	1	0.109438	[illegible]	2.048	0.0408
CENTSPRI	1	-0.095672	[illegible]	-1.031	0.3028
SMALSPRI	1	0.240451	0.164415	1.462	0.1438
RURLSPRI	1	0.127647	[illegible]	0.772	0.4400
INC2SPRI	1	-0.020210	0.055636	-0.363	0.7165
MALESUMM	1	0.067517	0.051166	1.320	0.1872
CENTSUMM	1	-0.315822	0.090068	-3.506	0.0005
SMALSUMM	1	0.136664	0.071886	1.901	0.0575
RURLSUMM	1	-0.058176	0.068578	-0.848	0.3964
INC1SUMM	1	- 0.182444	0.113485	1.608	0.1081
INC2SUMM	1	-0.047203	0.055359	-0.853	0.3940

[illegible] 18-74 YRS.

[illegible]: LLAD

	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB.
	66	6384795	96739.311	36.516	0.0001
	5003	13254211	2649.253		
	5069	19639005			
[illegible] MSE		51.470891	R-SQUARE	0.3251	
[illegible] MEAN		2.562781	ADJ R-SQ	0.3162	
C.V.		2008.4			

[illegible]BLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROBABILITY
[illegible]EP	1	1.910950	0.085375	22.383	0.0001
	1	1.394463	0.088466	15.763	0.0001
	1	0.260899	0.039438	6.615	0.0001
[illegible]	1	-0.118779	0.073382	-1.619	0.1056
[illegible]	1	-0.182339	0.070647	-2.581	0.0099
[illegible]AL	1	0.059343	0.026003	2.282	0.0225
MA[illegible]URL	1	0.118612	0.028026	4.232	0.0001
CENTER	1	0.112532	0.058218	1.933	0.0533
MALECEN	1	-0.020366	0.025151	-0.810	0.4181
SMALLCEN	1	0.011462	0.030324	0.378	0.7055
INCOME1	1	-0.056697	0.069552	-0.815	0.4150
INCOME2	1	-0.022510	0.042014	-0.536	0.5921
MALEINC1	1	-0.00136907	0.033975	-0.040	0.9679
MALEINC2	1	0.061235	0.020676	2.962	0.0031
SMALLIN1	1	0.020275	0.046289	0.438	0.6614
SMALLIN2	1	-0.044873	0.027843	-1.612	0.1071
RURALIN1	1	0.187979	0.052209	3.601	0.0003
RURALIN2	1	0.031518	0.029877	1.055	0.2915
INC1CEN	1	0.161479	0.043932	3.676	0.0002
INC2CEN	1	0.034510	0.026850	1.285	0.1988
NORTHEST	1	0.075717	0.077586	0.976	0.3292
MIDWEST	1	0.067698	0.083979	0.806	0.4202
SOUTH	1	-0.067067	0.083539	-0.803	0.4221
WINTER	1	-0.00471145	0.081411	-0.058	0.9539
[illegible]RG	1	-0.044426	0.042249	-1.052	0.2931
[illegible]ER	1	-0.052296	0.096676	-0.541	0.5886
[illegible]TSUMM	1	-0.158240	0.088552	-1.787	0.0740
[illegible]NORT	1	0.030379	0.033260	0.913	0.3611
[illegible]NORT	1	-0.143573	0.047432	-3.027	0.0025
SMALNORT	1	-0.013424	0.074477	-0.180	0.8570
[illegible]LLNORT	1	-0.031335	0.073658	-0.425	0.6706
INC1NORT	1	-0.082460	0.060253	-1.369	0.1712
INC2NORT	1	-0.00955633	0.035828	-0.267	0.7897
MIDWSPRI	1	-0.020408	0.086241	-0.237	0.8130
MIDWSUMM	1	-0.135636	0.091935	-1.475	0.1402
MALEMIDW	1	0.034427	0.032604	1.056	0.2911
CENTMIDW	1	-0.075055	0.048851	-1.536	0.1245

TEH 0533158

DUP050034428

SMALMIDW	1	-0.129370	0.073235	-1.767	0.0774
RURLMIDW	1	-0.020806	0.073647	-0.283	0.7776
INC1MIDW	1	-0.072313	0.052523	-1.377	0.1686
INC2MIDW	1	0.017238	0.035532	0.485	0.6276
SOUTWINT	1	0.032042	0.081392	0.394	0.6938
SOUTSPRI	1	-0.043608	0.083951	-0.519	0.6035
MALESOUT	1	0.057262	0.029594	1.935	0.0531
CENTSOUT	1	-0.00832775	0.043789	-0.190	0.8492
SMALSOUT	1	0.033007	0.051390	0.642	0.5207
RURLSOUT	1	-0.022928	0.052860	-0.434	0.6645
INC1SOUT	1	-0.077221	0.051156	-1.510	0.1312
INC2SOUT	1	0.015699	0.031604	0.497	0.6194
MALEWINT	1	0.007393266	0.034845	0.212	0.8320
CENTWINT	1	-0.122041	0.056611	-2.156	0.0311
SMALWINT	1	-0.049176	0.065339	-0.753	0.4517
RURLWINT	1	-0.041811	0.061230	-0.683	0.4947
INC1WINT	1	-0.017195	0.056281	-0.306	0.7600
INC2WINT	1	0.019249	0.037597	0.512	0.6087
MALESPRI	1	-0.019747	0.030720	-0.643	0.5204
CENTSPRI	1	-0.083489	0.044826	-1.863	0.0626
SMALSPRI	1	0.079218	0.079741	0.993	0.3205
RURLSPRI	1	0.041212	0.078800	0.523	0.6010
INC1SPRI	1	-0.024324	0.054527	-0.446	0.6555
INC2SPRI	1	0.029570	0.033173	0.891	0.3728
MALESUMM	1	-0.033426	0.030349	-1.101	0.2708
CENTSUMM	1	-0.013734	0.044688	-0.307	0.7586
SMALSUMM	1	0.185941	0.041740	4.455	0.0001
RURLSUMM	1	0.085338	0.042103	2.027	0.0427
INC1SUMM	1	0.130681	0.059047	2.213	0.0269
INC2SUMM	1	0.012985	0.032270	0.402	0.6874