Supplemental Materials for Pinelopi Koujianou Goldberg, "The Effects of the Corporate Fuel Efficiency Standards," *The Journal of Industrial Economics* 46 (1), March 1998, pp. 1-33

APPENDIX A: DATA

The primary data source for this project is the Consumer Expenditure Survey (1984-1990) conducted by the Bureau of Labor Statistics. The survey includes detailed information on the demographics and automobile holdings of about 7,000 distinct households per year. The information on automobiles includes the make/model and purchase price of each car, financing, disposal of old vehicles, and a large set of vehicle characteristics. Most importantly, the CES includes the mileage of each car owned by the household during each quarter.[1] This information is used to derive a measure of the utilization of each new car purchased; to measure the utilization of the new car, I average its mileage across the four quarters following its purchase. This procedure makes the results less sensitive to reporting error or extraordinary utilization in a single quarter. The mean utilization of new cars in the CES sample is 2252 miles per quarter, while the median is 1900 miles. Details about the data set as well as tables with summary statistics can be found in Goldberg (1995).

The CES file is supplemented by a data set on vehicle characteristics based on the Automotive News Market Data Book. The latter includes information on size, performance, fuel efficiency and standard options of various models and is used to construct the averages that are used in the demand estimation. Information on gasoline prices by region (incl. state and local taxes) is taken from the Statistical Abstract. This information is needed to compute the "Price per Mile" for each vehicle. A big advantage of focusing on the 1985-1990 period is that it includes the sharp decline of gas prices at the end of 1985 so that there is ample variation in the data to identify the consumer responses to lower operating vehicle cost.

Institutional details about the implementation of the CAFE standard as well as information about the classification of vehicles according to the "domestic content" criterion are taken from the Automotive News Market Data Book and Ward's Automotive Yearbook. This information is summarized in Table A1. The first column reports the effective CAFE standards for passenger cars for 1985-1990; the corresponding standard for trucks was 20 MPG during that period. The standards implemented in each year often deviate from what was initially announced by the

[1] Each household is interviewed in the CES for four consecutive quarters.

Department of Transportation (DOT). In 1986, for example, GM and Ford petitioned DOT to lower CAFE; the DOT responded by lowering the standard from the initially announced 27.5 MPG down to 26 MPG for the 1986-1988 period, and to 26.5 MPG for 1989.

Columns 3-10 in Table A1 report the percentage of American cars that are produced domestically as opposed to a foreign country. An interesting feature of the EPA classification rules is that as of 1990 there were no foreign brands classified as "domestic", and this despite the expansion of foreign transplants in the U.S. after 1987; even when certain models qualified as domestic according to the "domestic content" criterion (this is, for example, the case with the Honda Accord or the Toyota Camry), the EPA treated the combined fleet as imported. This implies that the variable α_i in the profit maximization conditions, indicating the fraction of production located in the U.S., is always zero in the case of foreign manufacturers. As for American cars, there has been a steady trend in the 1980's towards increasing the share of small cars produced abroad, but at the same time, the share of large cars produced abroad has increased too. This latter phenomenon has often been attributed to the existence of the CAFE standard.

Table A1: CAFE Standards and Shares of Domestically Produced Cars, 1985-90

	CAFE Standards	**Fraction of American Cars Produced in the U.S.**								
		Subc	Comp	Intm	Std	Lux	Spor	Trck	Van	Oth
85	27.5	0.877	1.000	1.000	0.896	1.000	1.000	0.981	1.000	1.000
86	26.0	0.818	1.000	0.998	0.911	1.000	1.000	0.979	1.000	1.000
87	26.0	0.777	0.983	0.995	0.907	0.995	1.000	0.980	1.000	1.000
88	26.0	0.641	0.961	0.987	0.819	0.997	1.000	0.986	1.000	0.993
89	26.5	0.596	0.953	0.905	0.832	0.995	0.990	0.991	1.000	0.965
90	27.5	0.753	0.939	0.999	0.871	0.961	0.981	0.996	1.000	0.996

List of Variables Used In The Estimation

A) Household characteristics

AGE	Age of Household Head
EDUC	1 if attended college
FEMALE	0: male, 1: female
INCOM	Household income after taxes
ASSET	Total Assets (Checking/Savings Accounts + U.S. Bonds + Stocks)
FAMSIZE	Family Size
PERSLT18	Number of Persons under 18
BIGCITY	1 if more than 1.25 million population size
ASIAN	1 if Asian
MINOR	1 if Black or Hispanic
BLUEC	1 if Blue Collar
UNEMPL	1 if unemployed
NE	1 if Northeast
NC	1 if Northcentral
WE	1 if West
CARSTOCK	Number of cars owned before new vehicle was purchased or before household was interviewed
NOCAR	1 if no car owned before
AVAGE	Average Age of the existing stock of cars
AVAGES	Square of AVAGE
AGENEW	Age of the newest car in the stock before purchase was made
AGENEWS	Square of AGENEWS
POWN	1 if household has purchased same vehicle type in the past

B) Vehicle Characteristics and Interactions with Household Characteristics[2]

SIZE	Square Root of (Length x Width)
SIZEF	Size x Famsize
WEIGHT	
HP	Horsepower

(continued on next page)

[2]All vehicle characteristics are sales-weighted averages by vehicle class.

B) Vehicle Characteristics... *(continued)*

HPW	Horsepower/Weight (Measure of engine power and acceleration)
HPWYOUNG	Horsepower/Weight if household head is less than 30
CYL	Number of cylinders
FUELC	1/Miles per Gallon (city estimate) x Regional Gasoline Price (incl. taxes). The Gasoline Price is for Unleaded Regular, taken from the Statistical Abstract.
TRANS	1 if car comes with automatic transmission
PS	1 if car has power steering
AIRC	1 if car has airconditioning
PRICE	Vehicle Price
CC1-CC8	Dummies corresponding to classes 1 to 8
CCS	Dummy for Small Cars (Subcompacts and Compacts)
CCL	Dummy for Large Cars (Standard, Light Trucks and Vans)
CCLX	Dummy for Expensive Cars (Luxury and Sports)

C) Other

D85-D90	Year Dummies
D1-D31	Dummies corresponding to the interview period of each household. For example, D1 refers to households interviewed between 83:2 and 84:1, D2 to the ones interviewed between 83:3 and 84:2, and so on.
MACY	Regional Disposable Personal Income per Capita (annual, Source: Statistical Abstract)
UNEMPLR	Regional Unemployment Rate (annual, Source: BLS, "Geographic Profile of Employment and Unemployment")
AUTOFINT	Average Interest Rate for (New and Used) Car Loans, (annual, Source: Federal Reserve Board, "Annual Statistical Digest")
CINCL1-9	Inclusive values for each market segment at the class choice node
NINCL	Inclusive value for new cars at the new/used node
BINCL	Inclusive value for buying a car at the buy/not buy node

APPENDIX B

Results from the Demand Estimation

Table B1: Foreign vs. Domestic

0: Domestic

1: Foreign

Variable	Parameter Estimate	Standard Error	T-Statistic
POWN	0.667	0.066	10.055
PRICE	-2.991	1.390	-2.150
FUELC	-0.425	0.138	-3.081
HPW	0.024	0.014	1.714
SIZE	0.023	0.016	1.449
TRANS	-0.497	0.344	-1.444
PS	0.899	0.181	4.957
AIRC	-0.275	0.360	-0.763
C1	-1.990	0.319	-6.244
AGE1	-0.006	0.004	-1.650
EDUC1	0.506	0.106	4.777
FAMSIZE1	-0.025	0.034	-0.738
NE1	-0.071	0.135	-0.525
NC1	-0.575	0.136	-4.216
WE1	0.535	0.131	4.074
ASIAN1	0.899	0.374	2.406
MINOR1	0.374	0.178	2.104
BLUEC1	-0.287	0.135	-2.128
UNEMPL1	-0.181	0.187	-0.967
BIGCITY1	0.143	0.106	1.351
INCOM1	0.428	0.201	2.127
D851	-0.355	0.187	-1.896
D861	0.327	0.181	1.806
D871	0.212	0.187	1.129
D881	-0.090	0.207	-0.436
D891	-0.182	0.190	-0.959
D901	0.159	0.202	0.785
CCS1	2.186	0.184	11.905
CCL1	-0.810	0.372	-2.177
CCLX1	1.726	0.213	8.092

Table B2: Class Choice

1-9: Class 1 - Class 9

Variable	Parameter Estimate	Standard Error	T-Statistic
CINCL	0.890	0.004	22.250
C2	0.431	0.246	1.750
AGE2	0.007	0.004	1.573
FAMSIZE2	-0.108	0.043	-2.502
BIGCITY2	-0.050	0.120	-0.417
INCOM2	-0.008	0.276	-0.031
BLUEC2	-0.083	0.157	-0.533
C3	-1.247	0.428	-2.914
AGE3	0.040	0.005	8.669
FAMSIZE3	-0.097	0.046	-2.117
BIGCITY3	-0.121	0.127	-0.949
INCOM3	0.018	0.286	0.063
BLUEC3	0.054	0.165	0.327
C4	-2.958	0.635	-4.660
AGE4	0.053	0.006	8.681
FAMSIZE4	-0.192	0.068	-2.819
BIGCITY4	0.004	0.177	0.021
INCOM4	0.769	0.363	2.118
BLUEC4	-0.173	0.255	-0.677
C5	-2.015	0.865	-2.330
AGE5	0.045	0.006	7.096
FAMSIZE5	-0.202	0.070	-2.901
BIGCITY5	0.111	0.184	0.602
INCOM5	1.527	0.331	4.607
BLUEC5	-1.041	0.351	-2.966
C6	-0.779	0.514	-1.517
AGE6	-0.003	0.007	-0.407
FAMSIZE6	-0.216	0.074	-2.912
BIGCITY6	0.140	0.194	0.721
INCOM6	1.115	0.396	2.907
BLUEC6	-0.038	0.257	-0.148

continued

Table B2: Class Choice *(continued)*

Variable	Parameter Estimate	Standard Error	T-Statistic
C7	0.483	0.391	1.236
AGE7	0.002	0.005	0.446
FAMSIZE7	0.024	0.043	0.552
BIGCITY7	-0.459	0.123	-3.749
INCOM7	0.270	0.278	0.971
BLUEC7	0.511	0.148	3.454
C8	-2.000	0.530	-3.775
AGE8	0.010	0.007	1.387
FAMSIZE8	0.205	0.061	3.349
BIGCITY8	-0.318	0.194	-1.639
INCOM8	0.577	0.401	1.438
BLUEC8	-0.431	0.276	-1.561
C9	-0.980	0.572	-1.712
AGE9	-0.019	0.011	-1.716
FAMSIZE9	-0.015	0.090	-0.170
BIGCITY9	-0.284	0.259	-1.094
INCOM9	2.022	0.426	4.737
BLUEC9	-0.515	0.398	-1.293

Table B3: New vs. Used

0: Used

1: New

Variable	Parameter Estimate	Standard Error	T-Statistic
C1	13.797	3.812	3.619
NINCL1	0.401	0.090	4.440
D851	0.830	0.219	3.786
D861	2.184	0.562	3.884
D871	2.549	0.660	3.860
D881	1.623	0.426	3.813
D891	1.496	0.442	3.382
D901	2.137	0.598	3.571
AGE1	0.015	0.002	8.978
EDUC1	0.547	0.050	10.879
MINOR1	-0.121	0.077	-1.561
BLUEC1	-0.320	0.053	-6.059
UNEMPL1	-0.133	0.074	-1.796
BIGCITY1	0.246	0.042	5.809
INCOM1	0.854	0.106	8.020
ASSET1	0.704	0.096	7.310
NOCAR1	-1.088	0.099	-11.001
CARSTOCK1	-0.136	0.029	-4.614
AVAGE1	-0.066	0.032	-2.080
AVAGES1	-0.004	0.002	-1.764
AGENEW1	-0.032	0.027	-1.205
AGENEWS1	0.002	0.002	1.122
UNEMPLR1	-0.311	0.067	-4.640
MACY1	-0.987	0.332	-2.972

Table B4: Buy vs. Not Buy

0: Not Buy

1: Buy

Variable	Parameter Estimate	Standard Error	T-Statistic
C1	8.625	8.342	1.034
AGE1	-0.011	0.001	-10.967
EDUC1	-0.229	0.030	-7.550
FAMSIZE1	0.210	0.008	24.958
NE1	0.067	0.086	0.782
NC1	0.048	0.061	0.786
WE1	0.201	0.180	1.117
FEMALE1	-0.301	0.030	-10.015
ASIAN1	-0.389	0.094	-4.155
MINOR1	-0.427	0.045	-9.544
UNEMPL1	-0.515	0.043	-12.064
BIGCITY1	-0.200	0.027	-7.368
INCOM1	0.610	0.067	9.005
ASSET1	0.499	0.056	8.782
NOCAR1	3.383	0.069	48.920
CARSTOCK1	0.178	0.019	9.416
AVAGE1	0.048	0.018	2.697
AGENEW1	0.009	0.015	0.592
AVAGES1	-0.003	0.001	-2.610
AGENEWS1	0.002	0.001	1.780
UNEMPLR1	0.122	0.099	1.230
MACY1	-16.230	7.220	-2.240
AUTOFINT1	-0.250	0.070	-3.560
D2-D31 Dummies (All of them highly significant)			