

Technical Report

**Light-Duty Automotive Technology and
Fuel Economy Trends Through 1989**

by

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I. Abstract

This, the seventeenth in this series of papers and reports, examines trends in light-duty vehicle fuel economy and technology usage for model years 1978 through 1989. Comparisons with previous years' data are made for the fleet as a whole and for number of cylinders, vehicle size class, inertia weight class, and market segment (Domestic, European, and Asian).

II. Introduction

Trends in vehicle technology and fuel economy for light-duty cars and trucks are examined in this report, as in preceding papers in this series [1-18].* Technology usage and vehicle performance are emphasized. To the extent possible, this report is based on the latest and most complete vehicle technology and fuel economy data available. The source database was frozen in late March 1989 and excludes some changes to existing vehicles or new vehicles scheduled for midyear introduction.

For 1978 through 1986, all data are "final CAFE" data.** For 1987, the data are final CAFE for almost all manufacturers. For 1988, final CAFE data was available for some, but not all manufacturers. For Model Year 1989, fuel economy label data were used. The *sales volumes* for all the 1989 model year data have been adjusted to agree with post-label (but pre-"final") information reported to the Department of Transportation and in reliable trade publications. This same procedure was used for those manufacturers for which "final CAFE" data for 1987 and 1988 were unavailable.

For consistency with the previous reports in this series, the *MPG data* in this paper have no road or CAFE correction factors. Where only one MPG value is presented, it is 55/45 combined MPG. All vehicle weights presented are inertia weights (nominally curb weight plus 300 lbs).

As in previous papers in this series, vehicle classification as to vehicle type, size class and manufacturer generally follows fuel economy label, *Gas Mileage Guide* and CAFE protocols; exceptions are listed in Appendix A. In some passenger car tables, market shares for Large Sedans and Wagons are aggregated as "Large," Mid-size Sedans and Wagons are aggregated as "Midsize," and "Small" includes everything else: Compacts, Subcompacts, Minicompacts, and Two-Seaters. For trucks, the larger Pickups, Vans and Utility Trucks are sometimes aggregated as "Large" trucks, and "Small" includes the smaller models. The truck size classification scheme used in this paper is explained in Reference 14.

Appendix B lists the model year 1989 nameplates and their average MPG as of the data freeze date.

This paper includes an estimate of 0 to 60 MPH acceleration time for cars, calculated from horsepower and inertia weight, as in reference 19.

* Numbers in brackets denote references listed at the end of the text.

** The light truck data in this paper include gross vehicle weights (GVW) up to 8,500 lbs for all model years, although emission standards for light trucks with GVW between 6,000 and 8,500 lbs were not in effect before 1979. For details on how data on 6,001-8,500 lbs light trucks were obtained for model years 1975 to 1979, see Reference 14.

III. General Car and Truck Trends

Table 1 gives major characteristics of passenger cars, light-duty trucks, and all light-duty vehicles (cars and light trucks) for model years 1975 to 1989. Total sales in model year 1989 are projected to be 10.3 million cars and 4.5 million trucks (14.8 million total).

Average 55/45 MPG for cars decreased from 28.6 to 28.2 since last year. Other changes since last year, consistent with this MPG decline, include a 61 lb. increase in inertia weight, a 0.1 second decrease in 0 to 60 acceleration time, and increases in horsepower and engine size.

Table 2 summarizes the recent trend for 18 of the variables in Table 1 for Passenger Cars. Of the eighteen indicators listed in Table 2, eleven have changed in a direction consistent with a decline in fuel economy, five changed in a direction promoting improvement, and two are inconclusive.

As shown in Figure 1, sales-weighted fuel economy has changed very little in the last few years, particularly for light trucks. This year's combined car and truck fleet will average 25.5 MPG. Between 1975 and 1981, 55/45 fuel economy improved about nine MPG for cars and about six for trucks. Since then, 55/45 fuel economy for cars has increased by only three MPG and for trucks by only one MPG.

Average inertia weight for cars dropped 1,000 lbs between 1975 and 1980, leveled off for a while, and has increased by nearly 100 lbs since 1987. The light truck weight trend is similar. Correspondingly, car and truck fuel economy gains through 1980 occurred mainly when inertia weight was reduced; fuel economy improvements since 1980 have come in spite of the stagnated weight trend.

Average engine size for cars and light trucks decreased considerably between 1975 and 1981: by more than 100 CID for cars and 64 for trucks. Since then, automobile engines have decreased another 20 CID. Light-truck engines downsized steadily until 1986, but truck engine CID has increased every year since then.

Average engine horsepower reached a minimum for cars in 1981 and for trucks in 1983, but has risen consistently since. Power per CID has increased steadily and significantly over the entire period; while advantage *could* have been taken of this to reduce CID and improve fuel economy, the MPG improvement has been foregone in favor of increased vehicle power and performance.

Manual transmission usage peaked in 1980 at 32 percent for cars and 53 percent for trucks. It has since dropped to 25 percent for cars and 32 percent for trucks. Four-wheel drive was used in about 20 percent of trucks in the late 1970s and early 1980s, and over 30 percent since 1984; 4WD appears in less than 5 percent of cars.

The last few years have seen a large increase in the use of fuel-injected engines. More than 91 percent of this year's trucks will have fuel-injected engines, as will more than 87 percent of the cars. By comparison, light trucks were 40 percent fuel-injected in 1986, and 12 percent in 1985. Diesel engine usage peaked in 1981 for cars and a year later for light trucks. Diesels have not been an important part of the U.S. light duty market for several years.

Figure 2 shows the cumulative distribution of MPG for model year 1989 passenger cars. More than 90 percent of the 1989 cars get between 20 and 35 MPG; less than one percent get less than 20 MPG, and less than 10 percent get more than 35 MPG.

Table 1 - Characteristics of 1975 to 1989 Light Duty Vehicles

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Cars															
Sales(000)	8237	9722	11300	11175	10794	9443	8733	7819	8002	10675	10791	11015	10811	10660	10286
Fraction	.806	.788	.800	.773	.778	.835	.827	.803	.777	.761	.746	.717	.715	.698	.694
City FE	13.7	15.2	16.0	17.2	17.7	20.3	21.7	22.3	22.1	22.4	23.0	23.7	23.8	24.2	23.8
Hwy FE	19.5	21.3	22.3	24.5	24.6	29.0	31.1	32.7	32.7	33.3	34.3	35.5	35.8	36.7	36.3
55/45 FE	15.8	17.5	18.3	19.9	20.3	23.5	25.1	26.0	25.9	26.3	27.0	27.9	28.1	28.6	28.2
Wt(lbs)	4058	4059	3944	3588	3485	3101	3076	3054	3112	3099	3093	3041	3032	3055	3116
Ton-MPG	32.3	35.5	36.4	35.9	35.4	36.6	38.9	40.1	40.7	41.1	41.9	42.6	42.7	43.8	44.1
Disp(CI)	288	287	279	251	238	188	182	175	182	179	177	167	162	161	162
CID/Lb	.068	.068	.068	.067	.065	.058	.057	.055	.056	.056	.055	.053	.052	.051	.051
% FWD	6.5	5.8	6.8	9.6	11.9	29.7	37.0	45.6	47.3	53.7	61.6	71.1	76.8	81.1	81.8
% 4WD					.3	.9	.7	.8	3.1	1.0	2.1	1.1	1.4	1.3	1.3
% Man.Tr	19.9	17.1	16.8	20.2	22.3	31.9	30.4	29.7	27.4	24.2	23.6	24.8	24.7	23.8	25.5
% Inject	5.1	3.2	4.2	5.1	4.7	6.9	8.8	17.0	28.3	39.4	53.5	65.1	73.1	84.3	87.4
% TBI						.7	2.6	9.8	18.9	24.4	32.0	28.4	30.3	28.7	26.6
% Port	5.1	3.2	4.2	5.1	4.7	6.2	6.1	7.2	9.5	15.0	21.4	36.7	42.9	55.6	60.7
% Carb	94.6	96.6	95.3	94.0	93.2	88.7	85.3	78.4	69.6	58.9	45.6	34.5	26.6	15.7	12.6
% Diesel	.2	.3	.5	.9	2.1	4.4	5.9	4.7	2.1	1.7	.9	.3	.2	.0	.0
Eng-Hp	136	134	133	124	119	100	99	99	104	106	111	111	113	118	121
Hp/CID	.515	.502	.516	.538	.545	.583	.594	.609	.615	.637	.671	.701	.731	.767	.787
Hp/Lb	.033	.032	.033	.034	.034	.032	.032	.032	.033	.034	.035	.036	.037	.038	.039
0 to 60	14.2	14.4	14.0	13.7	13.8	14.3	14.4	14.4	14.0	13.8	13.3	13.2	13.0	12.6	12.5
% Small	55.4	55.4	51.9	44.7	43.7	54.4	51.5	56.5	53.1	57.4	55.7	59.5	63.2	64.1	59.5
% Mid	23.3	25.2	24.5	34.4	34.2	34.4	36.4	31.0	31.8	29.4	28.9	27.9	24.6	22.8	25.3
% Large	21.3	19.4	23.5	21.0	22.1	11.3	12.2	12.5	15.1	13.2	15.4	12.6	12.1	13.0	15.2
Trucks															
Sales(000)	1987	2612	2823	3273	3088	1863	1821	1914	2300	3345	3669	4350	4305	4603	4546
Fraction	.194	.212	.200	.227	.222	.165	.173	.197	.223	.239	.254	.283	.285	.302	.306
City FE	12.1	12.8	14.0	13.8	13.4	16.5	17.8	18.1	18.3	17.9	18.0	18.8	18.8	18.2	18.2
Hwy FE	16.2	16.9	18.1	17.5	16.8	21.9	23.9	24.4	25.2	24.8	24.9	25.9	26.4	26.2	25.8
55/45 FE	13.7	14.4	15.6	15.2	14.7	18.6	20.1	20.5	20.9	20.5	20.6	21.4	21.6	21.1	21.0
Wt(lbs)	4072	4155	4135	4151	4252	3869	3806	3806	3763	3782	3795	3738	3731	3877	3906
Ton-MPG	28.4	30.5	33.0	32.4	32.1	36.3	38.8	39.6	39.9	39.3	39.6	40.4	40.6	41.1	41.3
Disp(CI)	311	319	318	314	298	248	247	243	231	224	224	211	213	229	230
CID/Lb	.076	.076	.076	.075	.069	.062	.063	.062	.060	.058	.058	.055	.056	.058	.058
% FWD						1.4	2.0	1.7	1.4	4.9	7.1	5.9	7.1	9.0	9.5
% 4WD	17.1	22.9	23.6	29.0	18.0	25.0	20.1	20.0	25.8	31.0	30.6	30.3	30.6	33.7	32.1
% Man.Tr	37.0	34.8	32.0	32.4	35.2	53.0	51.6	45.7	45.9	42.1	37.1	42.7	39.6	34.2	31.7
% Inject	.1	.1	.1	.1	.3	1.7	1.1	.7	.6	2.6	12.3	40.5	68.2	87.9	91.1
% TBI												18.7	32.2	44.8	45.6
% Port												21.8	36.0	43.2	45.5
% Carb	99.9	99.9	99.9	99.1	97.9	94.9	93.3	90.0	94.7	95.1	86.7	58.7	31.5	11.8	8.6
% Diesel				.8	1.8	3.5	5.6	9.3	4.7	2.3	1.1	.7	.3	.3	.3
Eng-Hp	142	141	147	146	138	121	119	120	118	118	124	123	132	142	144
Hp/CID	.476	.458	.482	.481	.486	.528	.508	.524	.543	.557	.586	.621	.646	.648	.655
Hp/Lb	.035	.034	.036	.035	.032	.031	.031	.032	.031	.031	.033	.033	.035	.037	.037
0 to 60	13.6	13.8	13.3	13.4	14.3	14.5	14.6	14.5	14.5	14.7	14.2	14.0	13.4	13.0	12.9
% Small	13.7	11.1	13.5	13.3	18.5	30.3	27.6	33.9	45.5	46.0	49.1	56.3	59.9	54.7	57.8
% Large	86.3	88.9	86.5	86.7	81.5	69.7	72.4	66.1	54.5	54.0	50.9	43.7	40.1	45.3	42.2

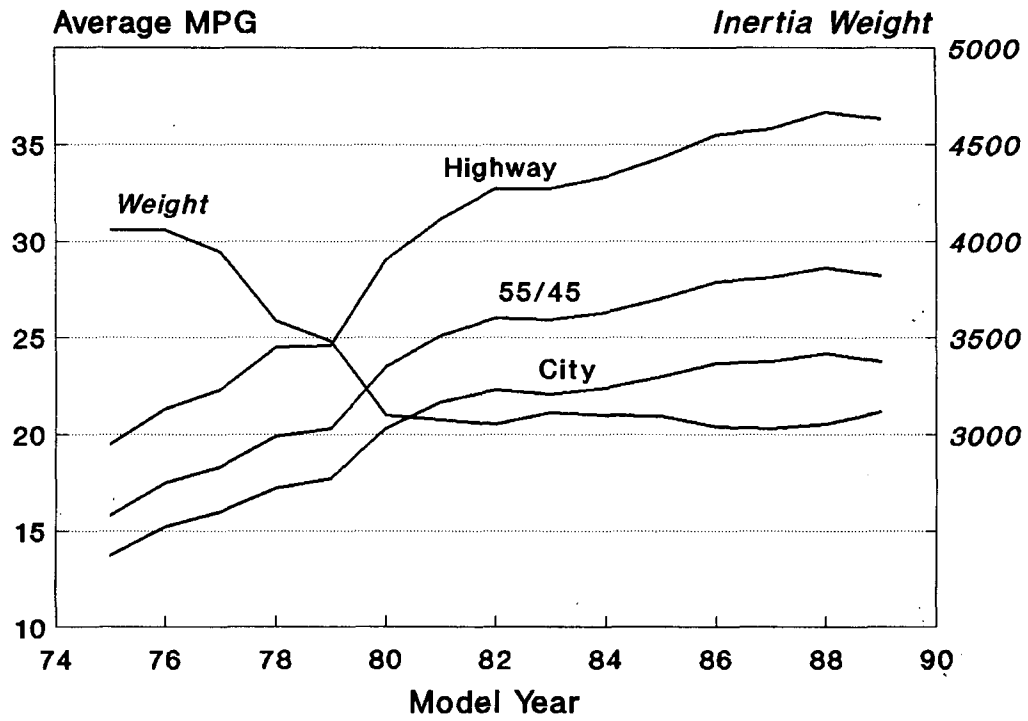
Table 1 - Characteristics of 1975 to 1989 Light Duty Vehicles (Continued)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Cars and Trucks															
Sales(000)	10224	12334	14123	14448	13882	11306	10554	9732	10302	14020	14460	15365	15116	15264	14832
City FE	13.4	14.6	15.6	16.3	16.5	19.6	20.9	21.3	21.2	21.2	21.5	22.1	22.1	22.0	21.8
Hwy FE	18.7	20.2	21.3	22.5	22.3	27.5	29.5	30.7	30.6	30.8	31.3	32.2	32.5	32.7	32.3
55/45 FE	15.3	16.7	17.7	18.6	18.7	22.5	24.1	24.7	24.6	24.6	25.0	25.7	25.9	25.8	25.5
Wt(Lbs)	4060	4079	3982	3715	3655	3228	3202	3202	3257	3262	3271	3238	3231	3303	3358
Ton-MPG	31.6	34.4	35.7	35.1	34.7	36.6	38.9	40.0	40.5	40.7	41.4	42.0	42.1	43.0	43.2
Disp(CI)	293	294	287	266	252	198	193	188	193	190	189	180	177	182	183
CID/Lb	.069	.069	.070	.069	.066	.059	.058	.056	.057	.056	.056	.054	.053	.053	.053
% FWD	5.3	4.6	5.5	7.4	9.2	25.0	31.0	37.0	37.0	42.1	47.8	52.6	57.0	59.3	59.7
% 4WD	3.3	4.8	4.7	6.6	4.3	4.9	4.0	4.6	8.1	8.2	9.3	9.3	9.7	11.1	10.7
% Man.Tr	23.2	20.9	19.8	23.0	25.1	35.4	34.1	32.8	31.5	28.5	27.0	29.8	28.9	26.9	27.4
% Inject	4.1	2.5	3.4	3.9	3.7	6.0	7.5	13.8	22.1	30.6	43.0	58.2	71.7	85.4	88.5
% TBI						.6	2.2	7.9	14.7	18.6	23.9	25.7	30.8	33.5	32.5
% Port	4.1	2.5	3.4	3.9	3.7	5.2	5.1	5.8	7.3	11.4	16.0	32.5	40.9	51.9	56.0
% Carb	95.7	97.3	96.2	95.2	94.2	89.7	86.7	80.6	75.2	67.6	56.1	41.4	28.0	14.5	11.4
% Diesel	.2	.2	.4	.9	2.0	4.3	5.9	5.6	2.7	1.8	.9	.4	.3	.1	.1
Eng-Hp	137	135	136	129	124	104	102	103	107	109	114	114	118	126	128
Hp/CID	.507	.493	.510	.525	.532	.574	.580	.593	.599	.618	.650	.678	.707	.731	.747
Hp/Lb	.033	.033	.034	.034	.034	.032	.032	.032	.033	.033	.035	.035	.036	.038	.038

Table 2 - Changes Affecting 1989 Passenger Car Fuel Economy

The 1989 Average for:	is:	This metric has not been this:	since:	Its effect is to make MPG:
-----	---	-----	-----	-----
City MPG	23.8	Low	1987	Worse
Hiway MPG	36.3	Low	1987	Worse
55/45 MPG	28.2	Low	1987	Worse
Engine CID	162	High	1988	Worse
Inertia Wt	3116	High	1983	Worse
Engine Hp	121	High	1978	Worse
Hp/Lb	.039	High	Ever	Worse
0 to 60 Time	12.5	Low	Ever	Worse
Percent Small Cars	59.5%	Low	1986	Worse
Percent Large Cars	15.2%	High	1985	Worse
Percent Diesel	0.006%	Low	1988	Worse
Ton MPG	44.1	High	Ever	Better
CID/Lb	.051	Low	1988	Better
Hp/CID	.787	High	Ever	Better
Percent FWD	81.8%	High	Ever	Better
Percent Manual Trans	25.5%	High	1983	Better
Percent Port FI	60.7%	High	Ever	--
Percent Midsize Cars	25.3%	High	1986	--

Passenger Car MPG by Model Year



Light Truck MPG by Model Year

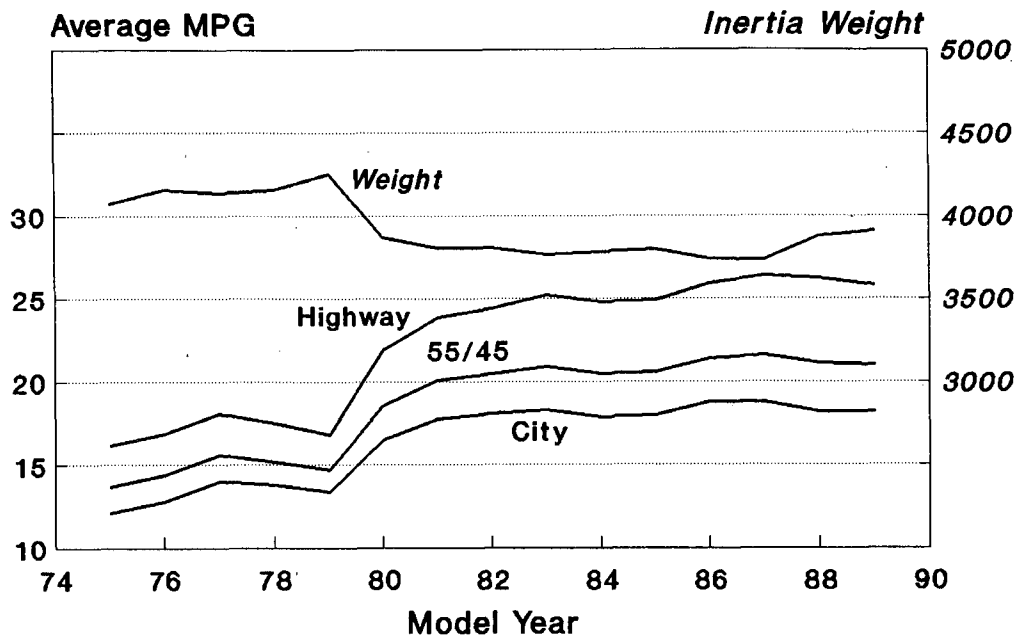


Fig. 1

Cumulative MPG Distribution 1989 Passenger Cars

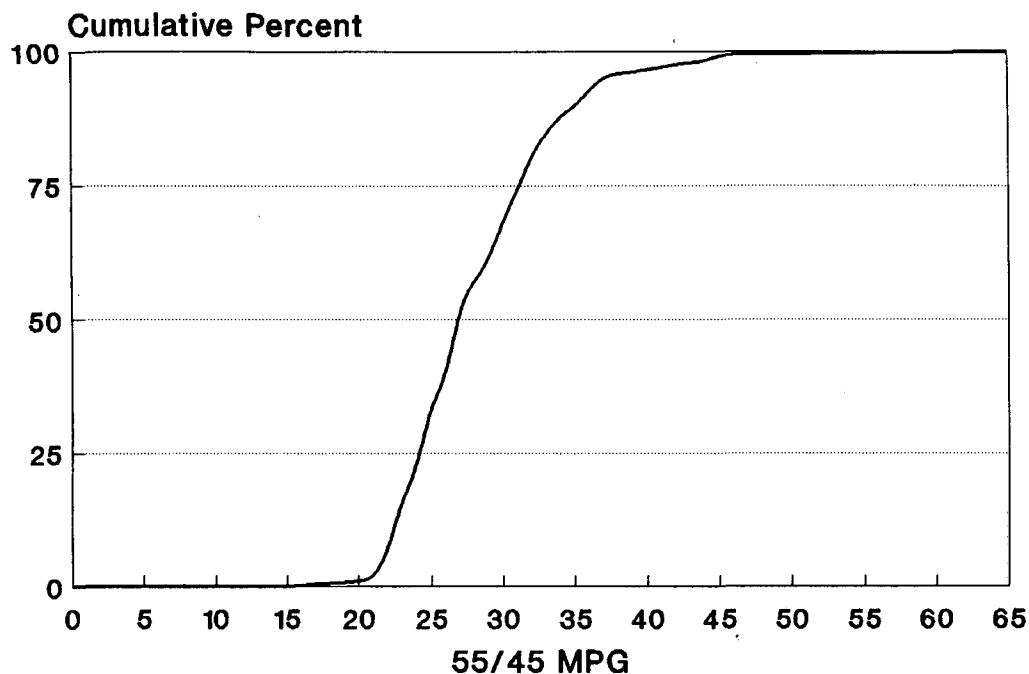


Fig. 2

IV. MPG Improvement Potential

A. Concept Overview

Vehicle fuel economy has remained essentially constant for years, and underwent a reversal in 1989; yet, the importance of vehicle fuel economy is increasing due to its direct connection with the greenhouse effect. Given this situation, it is meaningful to probe today's vehicle fleet to "mine" what potential exists there for improving fuel economy. This is obviously, and necessarily, a matter of hypothetical investigation. Of the many possible methods of applying hypothesis to the data base, this paper presents three:

- *"High MPG Cars" Scenario:* within each weight class, identification of the high MPG 1989 cars, and construction of a fleet consisting of just those cars, mixed in the same proportions by weight as the actual fleet. For symmetry, this was also done for the low MPG cars. The analysis divided each weight class into five equally-populated segments, by nameplates, and selected the top MPG fifth, or *quintile*, as the "high MPG cars;" the bottom quintile made up the "low MPG cars".
- *"High MPG Manufacturer's Cars" Scenario:* within each car size class, identification of the highest manufacturer's average MPG, and construction of a fleet consisting of just that manufacturer's cars in that class, with the classes mixed in the same proportions as the actual fleet. This was done similarly for the lowest manufacturer's average.

- *"Performance Adjustment" Scenario:* using sensitivity coefficients for the relation between MPG and 0-60 acceleration, the MPG data in recent model years, characterized by ever-increasing vehicle performance, were adjusted to correspond to the vehicle performance of prior model years.

B. High MPG Cars

Table 3 presents the results for the High MPG Cars scenario. The hypothetical fleets used in this scenario consist, on a MPG rank basis, of the top and bottom 20 percent, or quintile, of the nameplates in each inertia weight class. For this scenario, the inertia weight mix was held constant, so the high and low quintile fleets have the same average inertia weight as the actual fleet.

This scenario shows the potential for a 30.9 MPG fleet average using 1989 technology, with no sacrifice in interior volume, and with average acceleration performance better than all model years prior to 1985. Average interior volume for the high MPG case is the same as that of the actual 1989 fleet; the low MPG case has much lower volume.

Table 3
Results of "High MPG Cars" Analysis

	Low MPG Car Fleet	Actual Fleet	High MPG Car Fleet
	-----	-----	-----
Inertia Weight	3116	3116	3116
55/45 MPG	23.5	28.2	30.9
CID	192	162	146
Horsepower	154	121	110
0 to 60	10.7	12.5	13.3
Interior Volume	94	108	108
Percent Manual	36.1	25.5	41.3
Percent FWD	43.3	81.8	89.4
Percent Port FI	86.6	60.7	51.0

C. High MPG Manufacturer's Cars

It may be argued that the preceding High MPG Car Scenario is less than fully realistic because the hypothetical fleet made up of each *weight* class' best-MPG cars may not include a sufficiently variegated, "rational" mix of car types; the analysis technique does not even guarantee that each vehicle size/type, e.g. Midsize Station Wagon, is represented in the hypothetical data base.

The High MPG Manufacturer's Cars scenario is size class based, rather than weight class based, so representation of all size classes is ensured. Within each size class, each manufacturer's MPG average is determined, and the cars (all of them) from that manufacturer with the highest MPG average are retained in the hypothetical fleet. The low MPG case is handled similarly.

Table 4 illustrates the scenario applied to the 1989 fleet. The resulting high MPG fleet is made up of manufacturer B's Two-Seaters, manufacturer D's Minicom-pacts, etc., mixed in the "class market share" proportions of the overall fleet.

Table 4
High and Low MPG Manufacturers, by Car Class, 1989

Car Class	Class Market Share, %	Low MPG Mfr Mfr	MPG	Fleet Avg MPG	High MPG Mfr Mfr	MPG
Two-Seater	1.5	A	8.7	26.9	B	42.2
Minicompact	0.3	C	17.2	24.5	D	28.6
Subcompact	19.6	E	10.9	31.6	F	48.7
Compact	35.7	G	22.1	29.9	H	34.1
Midsize	22.8	I	12.5	26.5	J	27.7
Large	13.4	I	11.8	24.2	K	25.7
Small Wagon	2.4	L	29.7	31.3	B	34.7
Midsize Wagon	2.5	M	21.8	25.7	J	27.5
Large Wagon	1.8	J	22.8	22.8	N	23.2

Table 5 compares the high and low MPG results to the actual fleet for model year 1989. Under this scenario, a fleet average of 32.5 MPG could be achieved using 1989 technology, with no compromise in vehicle utility. The analysis was repeated for all model years back to 1978, revealing that last year's fleet showed even higher fuel economy potential: 1988 technology had the potential for a 33.9 MPG fleet average, as shown in Table 5.

Table 5
Characteristics of Best/Actual/Worst Fleets,
"High MPG Manufacturers" Scenario

	1989 Worst	1989 Actual	1989 Best	1988 Best
55/45 MPG	14.5	28.2	32.5	33.9
Interior Volume	111	108	109	106
Inertia Weight	4505	3116	2681	2594
CID	294	162	110	103
Horsepower	210	121	94	90
0 to 60	10.7	12.5	13.6	14.0
Percent Manual	13.2	25.5	39.9	46.4
Percent FWD	2.1	81.8	97.7	91.2

Figure 3 illustrates the high and low cases for this scenario, for all the model years. The high MPG potential was approaching 35 MPG until the MPG downturn of 1989, and the low MPG potential shows remarkable consistency.

MPG Improvement Potential "Best MPG Mfr's Cars" Scenario

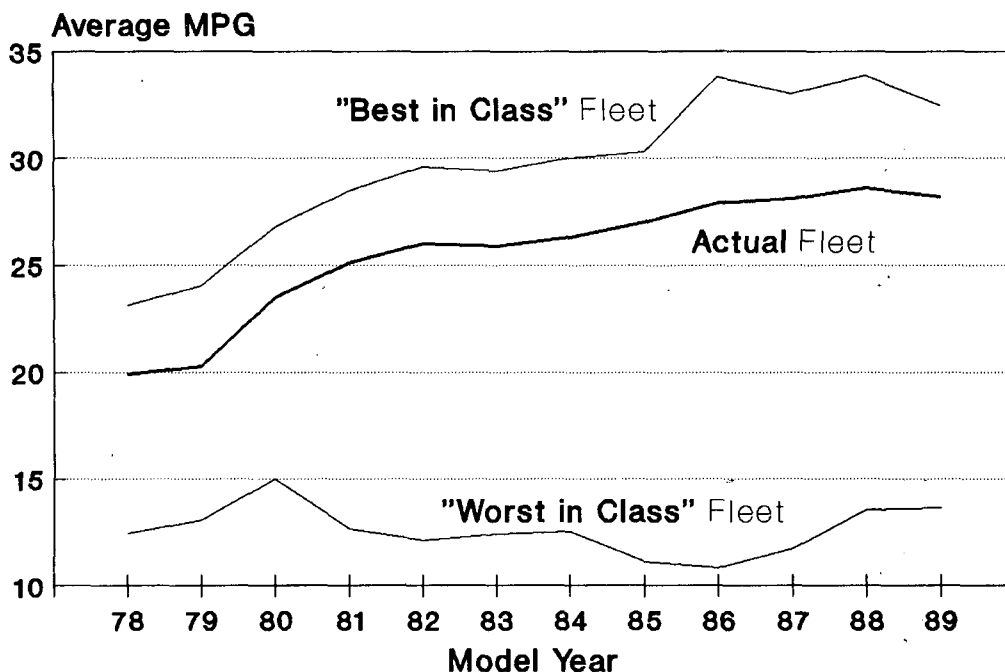


Fig. 3

D. Performance Effects/Adjustment

As shown in Figure 4, the fleet average 0 to 60 acceleration time was near or above 14 seconds until 1982, when it began dropping. The slope of the MPG trend curve clearly flattened after 1982; what had been a fuel economy improvement trend gave way to a performance improvement trend.

Fuel economy and acceleration performance are interrelated; Figure 5 shows the correlation between 0 to 60 acceleration time and MPG. Each data point in this graph represents an estimated 0 to 60 acceleration time and an average 55/45 fuel economy from the high MPG quintile (see section B above), low MPG quintile, or middle 60 percent of the 1989 fleet.

The MPG/performance interdependence was quantified by means of regression analysis performed on the EPA data bases. This yielded sensitivity coefficients on the order of 0.5, i.e. a 10 percent increase in 0 to 60 acceleration time corresponds to a 5 percent increase in fuel economy. Using these sensitivities, MPG data at one 0-60 level can be adjusted to what it would be at another 0-60 level. This was done for all model years from 1978 to 1989, for two performance levels selected as the adjustment bases: the 1979 fleet average level of 13.8 seconds, and the 1982 level of 14.4 seconds. The results appear in Figure 6, which shows that recent years' faster 0 to 60 acceleration times have cost up to 2 MPG in fleet fuel economy.

MPG and Performance Passenger Cars

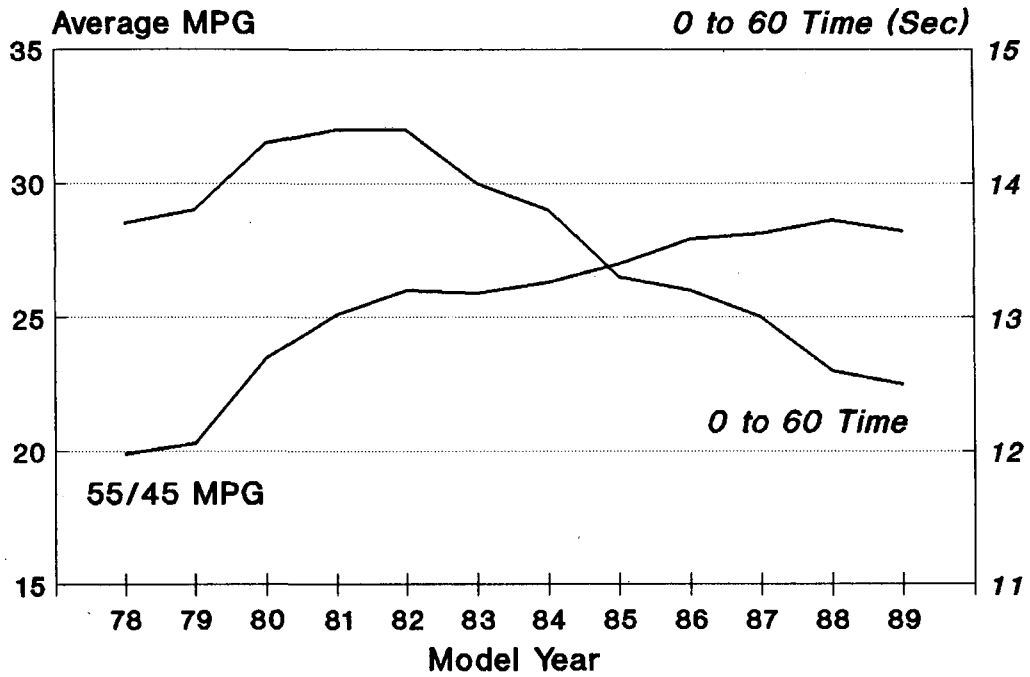


Fig. 4

Zero to 60 vs MPG by MPG Strata 1989 Passenger Cars

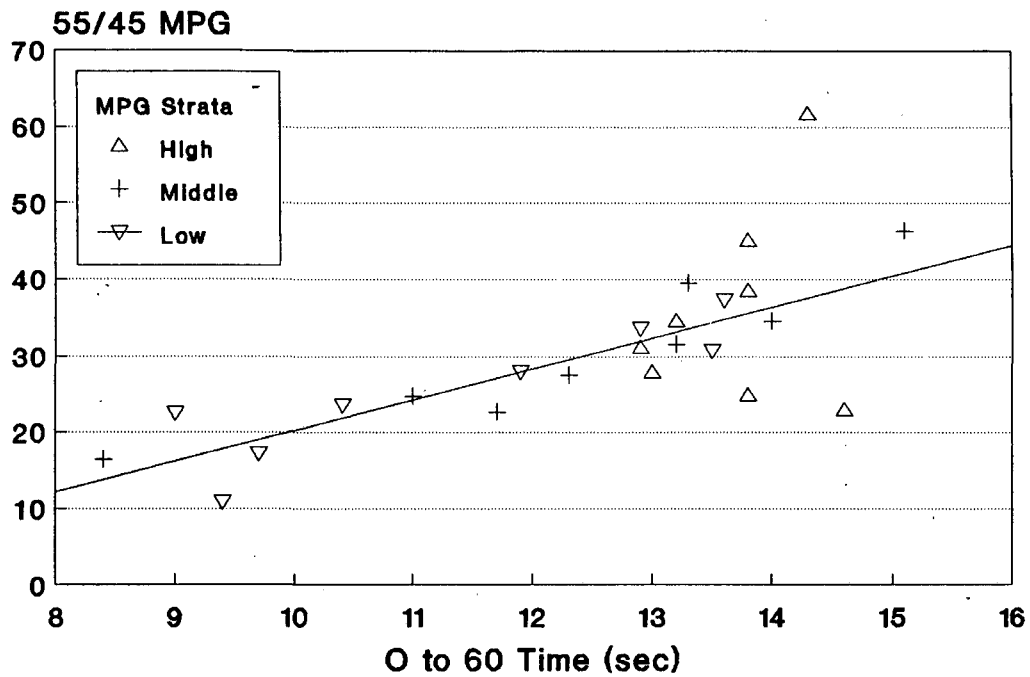


Fig. 5

MPG Sensitivity to Performance Passenger Cars

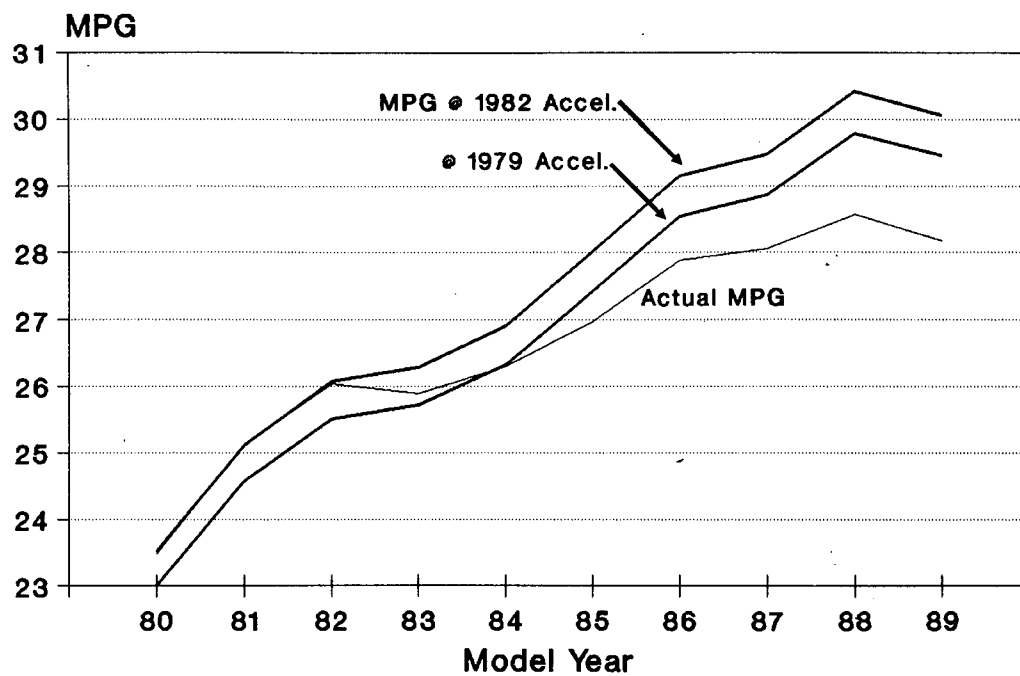


Fig. 6

V. Trends in Technology Usage

A. Catalysts

Tables 6 and 7 give market share, 55/45 MPG and vehicle weight by catalyst type for cars and trucks, respectively. Only a minuscule percentage of the cars built since 1984 have not had feedback control, so we no longer distinguish between vehicles with and without feedback.

Usage of oxidation-only catalysts in passenger cars essentially stopped in 1985. For 1985-87, the only cars with oxidation-only catalysts were vehicles such as Subaru four-wheel-drive sedans and wagons, which were certified as light trucks but classified as "cars" in this report. Except for a few trucks with thermal reactors, all gasoline-fueled trucks built since 1984 have used catalysts. Less than 2 percent of this year's trucks still use oxidation-only catalysts.

Usage of the three-way-plus-oxidation catalyst is dropping for both cars and light trucks. This combination accounted for 62 percent of the 1984 cars compared to 25 percent last year, and 18 percent this year. Similarly, the three-way-plus-oxidation catalyst combination accounted for 25 percent of the light trucks last year, and 22 percent this year.

Table 6 - Market Share, 55/45 MPG and IW of 1978 to 1989 Passenger Cars by Catalyst Type

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	----	----	----	----	----	----	----	----	----	----	----	----
No Catalyst	.102 27.0 2467	.085 27.2 2408	.046 25.9 2471									
Oxid. Catalyst	.887 19.2 3717	.868 19.6 3587	.790 23.3 3093	.142 30.0 2480	.132 32.6 2413	.124 33.0 2455	.006 27.1 2788	.004 28.0 2722	.005 28.1 2731	.006 27.3 2839		
3-Way Catalyst	.002 22.0 3188	.018 23.5 2982	.096 22.7 3150	.297 26.2 2967	.299 27.1 2977	.243 28.7 2869	.357 30.2 2754	.485 29.3 2837	.540 28.8 2945	.657 28.9 2966	.753 29.4 2971	.821 28.6 3063
3-Way + Oxid.		.007 16.8 4082	.025 20.1 3663	.502 23.1 3248	.523 24.0 3210	.612 23.8 3324	.621 24.3 3296	.502 24.9 3339	.452 26.8 3159	.335 26.5 3162	.247 26.3 3309	.179 26.2 3357
Diesel	.009 29.4 3498	.021 27.1 3873	.044 30.0 3487	.059 29.9 3589	.047 30.6 3602	.021 30.8 3633	.017 36.3 3202	.009 34.2 3275	.003 40.5 2906	.002 30.5 3584	.000 37.4 3000	.000 44.3 2884

Table 7 - Market Share, 55/45 MPG and IW of 1978 to 1989 Light Trucks by Catalyst Type

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	----	----	----	----	----	----	----	----	----	----	----	----
No Catalyst	.705	.084	.107	.035	.000	.022		.009				
	14.5	22.8	24.2	27.8	28.8	22.3		21.6				
	4260	2821	2773	2728	2750	3154		3203				
Oxid. Catalyst	.287	.898	.849	.839	.795	.741	.623	.530	.395	.181	.018	.016
	17.3	14.2	17.9	19.4	20.2	20.7	20.2	19.7	19.8	21.4	22.4	26.3
	3878	4371	3986	3913	3769	3816	3851	3957	3972	3695	3188	2834
3-Way Catalyst			.010	.032	.052	.076	.122	.261	.459	.579	.726	.762
			19.2	23.3	23.8	22.0	22.5	24.2	23.1	22.2	22.0	22.0
			3622	3034	3120	3372	3367	3346	3514	3672	3773	3802
3-Way + Oxid.			.000	.038	.060	.113	.232	.189	.138	.237	.253	.220
			13.4	18.6	15.3	19.3	19.8	18.7	21.3	20.4	18.8	17.9
			6500	3925	4279	3536	3764	3945	3764	3891	4207	4327
Diesel	.008	.018	.035	.056	.093	.047	.023	.011	.007	.003	.003	.003
	21.2	21.1	24.3	32.0	27.0	27.0	27.4	26.1	26.7	25.6	22.2	22.6
	4383	4977	4437	3213	4192	4388	4291	4578	4550	4719	5534	5198

B. Engines

1. Engine Size

Tables 8 and 9 describe 1978 to 1989 cars and light trucks by number of cylinders. Only 4-, 6-, and 8-cylinder engines are shown in these two tables because vehicles with other numbers of cylinders (e.g., 3-, 5- and 12-) have never accounted for more than a percent or two of the car and truck fleets. The calculation of the sales fractions in these tables, however, include all vehicles, regardless of number of cylinders. Thus, in 1983, cars with 4, 6, or 8 cylinders accounted for 98.4 percent of the car fleet; the remaining 1.6 percent of the fleet consisted of cars with other cylinder counts.

Since 1978, passenger car average displacement-- for each cylinder count--has changed very little, although average engine size of the overall fleet has dropped by 89 CID due to changes in the mix of engines. This year's cars with 4-cylinder engines average 11 CID larger than 1978's, while the 6- and 8-cylinder engines are smaller by 28 and 34 CID, respectively.

Average displacement for 8-cylinder car and light truck engines has remained constant at nominal values of 300 and 320 CID respectively for several years. This year's 8-cylinder cars and trucks are the heaviest since 1983. Use of 8-cylinder engines continues to drop: the sales fraction of 8-cylinder engines in cars decreased from 53 percent in 1978 to 10 percent this year. Figure 7 shows the market fraction for passenger cars by number of cylinders. In 1978, nearly three-fourths of the light trucks had 8-cylinder engines, compared to about one-fourth in the past four years.

The 6-cylinder market share has now increased to about 33 percent for cars, and has more that doubled for trucks since 1978. The market share of 4-cylinder trucks peaked at 40 percent in 1986, but is still more than double what it was in 1978. At the number of cylinders level of stratification, there has been little improvement in fuel economy the last six years for either cars (Figure 8) or trucks.

Table 8 - Characteristics of 1978 to 1989 Passenger Cars by Number of Cylinders

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	----	----	----	----	----	----	----	----	----	----	----	----
Four												
Sales(000)	2942	3184	4600	4542	4311	4260	5884	6059	6542	6883	6380	5847
Fraction	.263	.295	.487	.520	.551	.532	.551	.562	.594	.637	.598	.568
55/45 FE	28.3	27.0	27.9	29.7	30.8	31.0	31.1	31.3	31.2	31.1	31.7	31.4
Wt(Lbs)	2519	2571	2579	2560	2607	2630	2664	2676	2720	2727	2742	2769
Ton-MPG	36.1	35.0	36.3	38.4	40.4	41.2	41.8	42.3	42.7	42.7	43.7	43.8
Disp(CI)	108	111	116	116	115	119	120	121	122	121	119	119
CID/Lb	.043	.043	.045	.045	.044	.045	.045	.045	.045	.044	.043	.043
% FWD	31.6	33.3	44.8	60.3	71.6	74.8	80.7	83.0	88.7	90.7	92.6	93.3
% 4WD		1.2	1.0	.9	.9	5.0	1.4	3.7	1.6	2.1	1.9	2.0
% Man.Tr	67.1	65.8	60.4	55.3	49.0	47.1	40.0	38.5	36.9	35.0	35.3	39.3
% Inject	10.4	7.0	9.5	7.9	18.9	32.3	44.2	51.8	63.6	68.0	79.1	82.4
% TBI					11.0	20.5	27.8	32.5	38.5	41.9	43.4	41.5
% Port	10.4	7.0	9.5	7.9	7.9	11.8	16.4	19.3	25.1	26.1	35.8	40.9
% Carb	87.4	90.6	86.7	87.8	77.7	66.1	53.9	46.8	36.0	31.9	20.8	17.5
% Diesel	2.2	2.4	3.8	4.3	3.4	1.6	1.9	1.3	.4	.1	.0	.1
Eng-Hp	78	77	78	79	78	81	86	90	91	93	96	99
Hp/CID	.726	.707	.682	.693	.686	.695	.719	.753	.755	.773	.815	.837
Hp/Lb	.031	.030	.030	.031	.030	.031	.032	.034	.033	.034	.035	.035
0 to 60	14.7	14.9	14.8	14.6	14.9	14.6	14.3	13.9	13.9	13.8	13.5	13.3
% Small	97.6	95.8	89.7	82.9	84.1	79.8	84.4	81.3	79.5	81.6	86.6	86.0
% Mid	2.4	4.2	10.3	17.1	15.9	20.2	15.6	18.7	20.3	18.2	13.2	13.7
% Large								.0	.2	.2	.2	.4
Cu.Ft	89	90	93	97	98	101	100	101	102	102	101	101
Cu.Ft MPG	2579	2484	2643	2937	3056	3181	3168	3230	3233	3199	3260	3251
Cu.Ft Ton MPG	3216	3163	3376	3734	3963	4147	4190	4291	4373	4337	4434	4451
Six												
Sales(000)	2351	2250	2674	2411	2122	1879	2457	2503	2752	2535	3029	3373
Fraction	.210	.208	.283	.276	.271	.235	.230	.232	.250	.235	.284	.328
55/45 FE	20.2	20.4	21.6	22.6	23.0	23.8	24.1	24.0	24.9	25.1	25.9	25.6
Wt(Lbs)	3478	3412	3336	3384	3389	3379	3365	3388	3373	3414	3382	3457
Ton-MPG	35.2	34.9	36.1	38.4	39.2	40.4	40.5	40.8	42.0	42.9	44.0	44.3
Disp(CI)	220	216	212	215	212	211	205	206	199	199	193	192
CID/Lb	.063	.063	.064	.063	.062	.062	.061	.061	.059	.058	.057	.056
% FWD	1.0	1.2	21.7	14.2	19.1	22.3	31.5	48.5	63.9	73.4	83.4	82.1
% 4WD			1.5	.8	1.1	1.7	.9	.0	.4	.3	.7	.4
% Man.Tr	9.1	10.4	8.2	5.4	7.0	6.6	6.1	6.3	7.1	7.8	7.1	8.1
% Inject	6.2	7.4	4.2	6.8	17.4	12.4	29.9	62.8	80.6	96.7	98.8	100.0
% TBI					7.8		8.8	21.6	15.1	7.8	1.5	.2
% Port	6.2	7.4	4.2	6.8	9.6	12.4	21.1	41.2	65.5	89.0	97.2	99.8
% Carb	93.7	91.9	94.6	92.4	79.9	84.7	68.7	36.7	19.2	2.4	1.2	
% Diesel	.1	.7	1.1	.9	2.7	2.9	1.4	.6	.3	.8		
Eng-Hp	107	109	110	110	114	116	117	124	134	143	141	147
Hp/CID	.498	.516	.530	.523	.551	.567	.586	.617	.687	.732	.742	.779
Hp/Lb	.031	.032	.033	.033	.034	.035	.035	.037	.040	.042	.042	.043
0 to 60	14.8	14.4	14.0	14.1	13.8	13.6	13.4	12.9	12.1	11.6	11.6	11.5
% Small	54.6	42.1	29.7	23.7	26.3	32.3	30.0	30.2	34.6	36.7	33.9	26.9
% Mid	43.4	56.3	66.0	70.0	63.9	63.4	66.9	55.9	44.5	39.8	45.6	49.9
% Large	2.1	1.6	4.3	6.3	9.8	4.3	3.1	13.9	21.0	23.6	20.5	23.2
Cu.Ft	109	108	111	111	112	111	111	112	112	113	114	115
Cu.Ft MPG	2204	2211	2408	2528	2591	2659	2682	2695	2799	2860	2965	2946
Cu.Ft Ton MPG	3836	3788	4012	4291	4409	4498	4513	4564	4728	4884	5009	5089

Table 8 - Characteristics of 1978 to 1989 Passenger Cars by Number of Cylinders (Continued)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	----	----	----	----	----	----	----	----	----	----	----	----
Eight												
Sales(000)	5882	5361	2169	1780	1386	1863	2334	2229	1721	1393	1251	1067
Fraction	.526	.497	.230	.204	.177	.233	.219	.207	.156	.129	.117	.104
55/45 FE	17.2	17.6	19.1	20.3	20.3	20.1	20.4	21.7	23.1	22.1	22.8	22.6
Wt(lbs)	4166	4058	3920	3973	3931	3944	3914	3895	3729	3846	3857	3940
Ton-MPG	36.1	35.9	37.9	40.9	40.4	39.7	40.0	42.3	43.2	42.7	44.0	44.7
Disp(CI)	336	324	309	307	304	298	299	296	289	299	301	302
CID/Lb	.081	.080	.079	.077	.077	.076	.077	.076	.077	.078	.079	.077
% FWD	2.1	3.7	7.6	8.8	5.4	9.6	9.2	18.2	15.7	14.1	16.3	18.3
% 4WD												
% Man.Tr	1.2	1.4	.8	1.0	4.5	3.4	3.2	2.5	6.8	4.4	5.3	5.2
% Inject	1.9	2.2	4.4	13.7	10.3	35.3	37.3	47.4	46.4	55.7	75.7	74.4
% TBI			3.0	12.9	9.0	34.3	32.2	42.3	11.7	13.9	19.7	28.6
% Port	1.9	2.2	1.4	.8	1.3	1.0	5.1	5.1	34.7	41.8	56.0	45.8
% Carb	97.5	95.3	85.8	69.4	78.1	62.5	61.3	52.5	53.6	44.3	24.3	25.6
% Diesel	.6	2.6	9.8	16.9	11.6	2.2	1.4	.1				
Eng-Hp	154	149	135	133	138	143	144	151	148	156	177	163
Hp/CID	.460	.461	.439	.440	.459	.482	.484	.509	.521	.521	.587	.540
Hp/Lb	.037	.037	.035	.034	.036	.036	.037	.039	.040	.041	.046	.042
0 to 60	12.8	12.9	13.6	14.0	13.4	12.9	12.8	12.4	12.2	12.0	11.0	11.8
% Small	14.2	13.4	9.9	8.8	17.3	12.9	18.3	14.9	23.1	20.7	22.9	17.7
% Mid	46.8	42.8	46.4	40.0	27.2	26.5	24.5	26.4	30.4	29.0	17.0	11.2
% Large	39.0	43.8	43.7	51.2	55.6	60.6	57.3	58.7	46.4	50.3	60.1	71.1
Cu.Ft	119	121	121	123	123	125	122	123	119	120	122	126
Cu.Ft MPG	2085	2144	2343	2540	2528	2516	2497	2670	2799	2674	2793	2876
Cu.Ft Ton MPG	4317	4340	4616	5074	5031	4992	4927	5227	5163	5174	5425	5730

Table 9 - Characteristics of 1978 to 1989 Light Trucks by Number of Cylinders

		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
		----	----	----	----	----	----	----	----	----	----	----	----	
Four	Sales	342	481	585	522	518	744	1083	1253	1802	1567	1237	1210	
	Fraction	.105	.156	.314	.287	.270	.324	.324	.342	.414	.364	.269	.266	
	55/45 FE	26.2	23.1	24.3	27.3	27.4	27.2	26.4	26.1	26.3	26.4	26.1	25.8	
	Wt(Lbs)	2849	2850	2842	2861	2897	2924	3064	3157	3159	3123	3145	3200	
	Ton-MPG	37.7	33.6	35.1	39.9	40.4	40.3	40.8	41.5	41.7	41.3	41.2	41.3	
	Disp(CI)	121	123	124	130	132	135	135	141	139	139	140	143	
	CID/Lb	.042	.043	.044	.046	.046	.046	.044	.045	.044	.045	.045	.045	
	% FWD			4.5	6.4	6.2	4.2	15.1	20.7	14.1	10.2	8.0	16.3	
	% 4WD	6.8	20.5	22.2	24.5	23.3	19.2	21.3	21.7	24.7	25.9	31.2	19.0	
	% Man.Tr	88.1	86.4	90.0	92.9	88.9	84.8	75.9	65.9	72.6	72.6	73.6	66.6	
	% Inject	.8	1.8	5.3	3.9	2.4	2.0	7.9	27.7	34.8	40.0	60.7	71.1	
	% TBI									18.5	22.6	33.5	38.8	
	% Port									16.3	17.5	27.2	32.2	
	% Carb	99.2	98.2	92.8	80.6	82.0	92.5	88.8	71.1	64.4	59.7	39.3	28.9	
	% Diesel			1.9	15.5	15.6	5.6	3.3	1.2	.8	.2			
	% Small	100.0	99.2	89.4	90.4	86.6	92.0	79.6	77.7	81.0	87.9	86.5	91.2	
	% Large		.8	10.6	9.6	13.4	8.0	20.4	22.3	19.0	12.1	13.5	8.8	
	Six	Sales	558	515	555	636	642	751	1200	1217	1379	1832	2040	2156
		Fraction	.171	.167	.298	.350	.336	.327	.359	.332	.317	.426	.443	.474
55/45 FE		17.9	17.2	18.8	19.7	20.9	21.1	20.8	21.5	20.9	21.4	21.6	21.4	
Wt(Lbs)		3973	4066	4016	3956	3693	3754	3730	3704	3793	3803	3802	3880	
Ton-MPG		35.9	35.4	38.0	39.2	38.7	39.7	38.9	39.9	39.7	40.7	41.3	41.6	
Disp(CI)		273	264	269	272	243	229	221	216	218	223	219	224	
CID/Lb		.069	.066	.067	.069	.066	.061	.059	.058	.057	.058	.058	.058	
% FWD											8.0	15.4	10.8	
% 4WD		14.6	19.5	18.3	14.5	12.8	32.4	41.2	43.0	37.8	34.2	34.9	40.3	
% Man.Tr		32.0	61.0	61.9	57.3	52.5	48.5	41.4	37.7	33.3	27.1	27.3	26.9	
% Inject									.5	58.3	90.6	98.5	98.6	
% TBI									.5	34.7	33.7	39.1	38.4	
% Port										23.5	56.9	59.3	60.2	
% Carb		99.8	99.3	99.1	100.0	100.0	100.0	100.0	99.5	41.6	9.4	1.5	1.4	
% Diesel		.2	.7	.9						.1				
% Small		9.8	10.9	6.4	4.6	31.3	48.0	56.5	67.9	71.8	65.6	71.0	69.2	
% Large		90.2	89.1	93.6	95.4	68.7	52.0	43.5	32.1	28.2	34.4	29.0	30.8	
Eight		Sales	2373	2092	723	662	754	804	1062	1198	1169	906	1326	1179
		Fraction	.725	.677	.388	.364	.394	.350	.317	.327	.269	.210	.288	.259
	55/45 FE	13.9	13.2	15.4	16.9	17.2	17.0	16.5	16.3	17.1	16.7	17.4	17.2	
	Wt(Lbs)	4381	4620	4585	4405	4526	4547	4573	4555	4563	4637	4675	4679	
	Ton-MPG	30.8	30.9	35.9	37.6	39.9	39.7	38.3	37.5	39.2	39.0	40.9	40.5	
	Disp(CI)	352	347	333	315	319	321	320	318	315	323	328	329	
	CID/Lb	.081	.075	.073	.072	.071	.071	.070	.070	.069	.070	.071	.071	
	% FWD				.5	.1			.0	.0	.0		.0	
	% 4WD	35.5	17.0	32.5	22.0	24.0	25.6	29.3	27.4	29.9	31.3	34.2	30.6	
	% Man.Tr	24.4	17.0	16.3	13.6	10.2	7.4	8.5	6.5	7.6	7.8	8.1	4.5	
	% Inject								8.1	28.5	71.7	97.1	98.0	
	% TBI									.0	46.1	63.9	65.8	
	% Port								.0	28.4	25.7	33.2	32.1	
	% Carb	98.9	97.5	93.4	96.8	87.0	91.7	96.0	89.9	70.2	27.5	2.0	1.0	
	% Diesel	1.1	2.5	6.6	3.2	13.0	8.3	4.0	2.0	1.3	.8	.9	1.0	
	% Small	1.6	1.8	1.0	.3						.0		2.8	
	% Large	98.4	98.2	99.0	99.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	97.2	

Engine Size Market Shares Passenger Cars

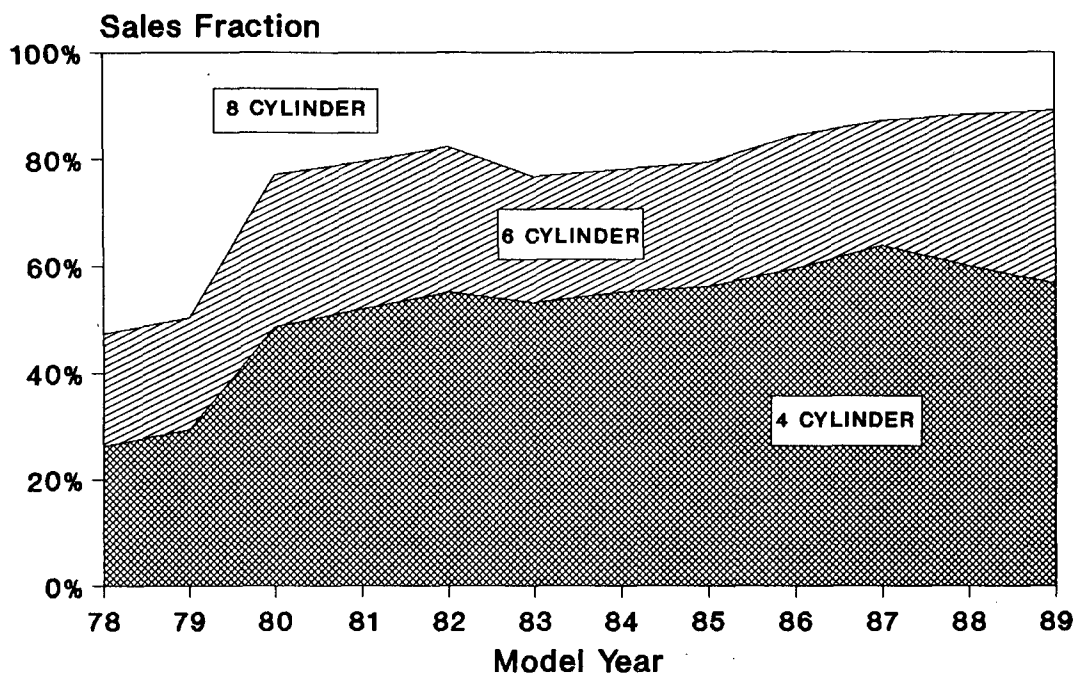


Fig. 7

MPG by Number of Cylinders Passenger Cars

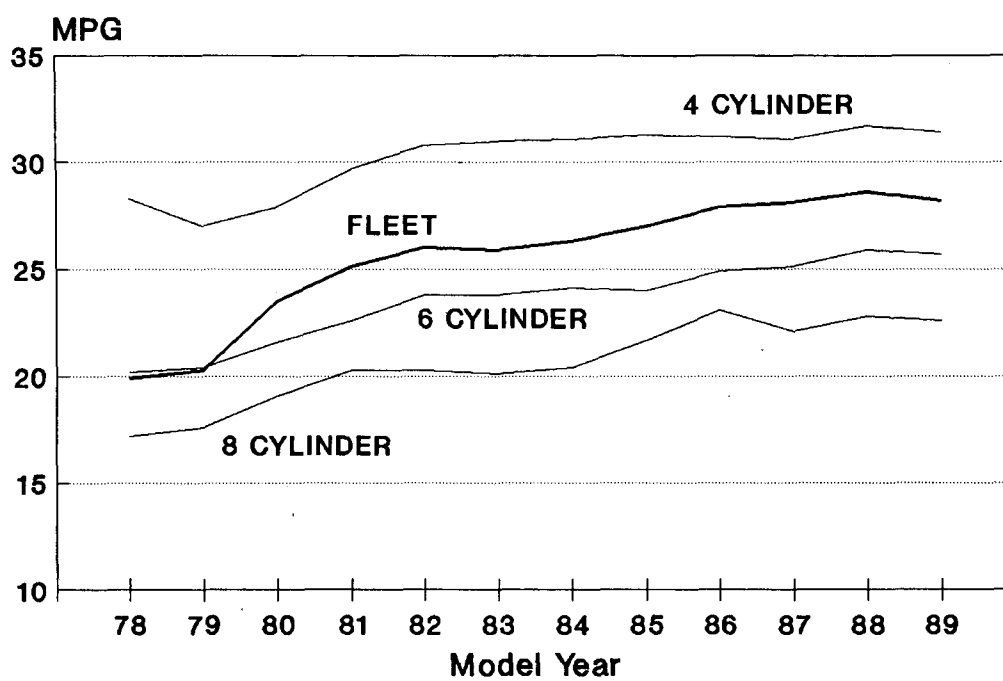


Fig. 8

2. Power and Performance

Figure 9 shows average engine horsepower for cars with 4-, 6-, and 8-cylinder engines. In 1978, 8-cylinder engines had twice the horsepower of the fours. Between 1978 and 1981, 8-cylinder engine horsepower decreased 21 HP, when use of Diesel engines increased to nearly 17 percent of the 8-cylinder car engines. Since then, as the use of Diesel and carbureted 8-cylinder engines decreased, their horsepower has increased and is now slightly higher than it was in 1978.

Horsepower of 6-cylinder car engines was constant at a nominal value of 110 HP between 1978 and 1981. Since then, 6-cylinder car engines have increased usage of port fuel injection to nearly 100 percent; their weight has increased 73 lbs, their displacement has decreased from 215 to 192 CID, their horsepower has increased substantially from 107 to 147, and their 0 to 60 acceleration time decreased from 14.1 to 11.5 seconds.

Horsepower of 4-cylinder car engines remained constant at about 80 HP through 1982. Since then, horsepower of 4-cylinder car engines has increased to nearly 100 HP, while their cubic-inch displacement has remained at about 120 CID. Cars with 4-cylinder engines have reduced their estimated 0 to 60 acceleration time to 13.3 seconds.

Figure 10 gives 0 to 60 acceleration time for passenger cars by number of engine cylinders. In 1978, cars with 4- and 6-cylinder engines had about the same 0 to 60 acceleration time (i.e. about 14.7 seconds). Since then, the sixes have reduced their acceleration time by 22 percent, or 3.3 seconds, to about the same value as cars with 8-cylinder engines.

3. Fuel Metering

Figure 11 compares fuel metering used in cars with 4-, 6-, and 8- cylinder engines. Essentially, all of this year's cars with 6-cylinder engines will have port fuel injection compared to 41.5 percent of the 4- cylinder, and 46 percent of the 8-cylinder engines. The use of throttle body injection appears to have peaked for both 4- and 8-cylinder engines.

Over 90 percent of this year's cars with 4-cylinder engines have front-wheel drive, as will over 80 percent of the cars with 6-cylinder engines. Conversely, only 18 percent of this year's cars with 8-cylinder engines have front-wheel drive; The others still have rear drive. Similarly, a fourth of the 8-cylinder car engines built this year are carbureted. All of these 8-cylinder carbureted engines are used in cars with rear drive and automatic transmission such as the Chevrolet Caprice, Buick LeSabre and Dodge Diplomat.

Nearly 99 percent of this year's trucks with 6-cylinder engines will be fuel injected, compared to 58 percent in 1986 and 0.5 percent in 1985. Similarly, nearly 98 percent of this year's trucks with 8-cylinder engines will be fuel injected, compared to 8 percent for 1985. Less than a third of this year's trucks with 4-cylinder engines will be carbureted. Model year 1989 is the first for which fuel injection exceeds 87 percent for both cars and trucks.

Average Engine Horsepower Passenger Cars

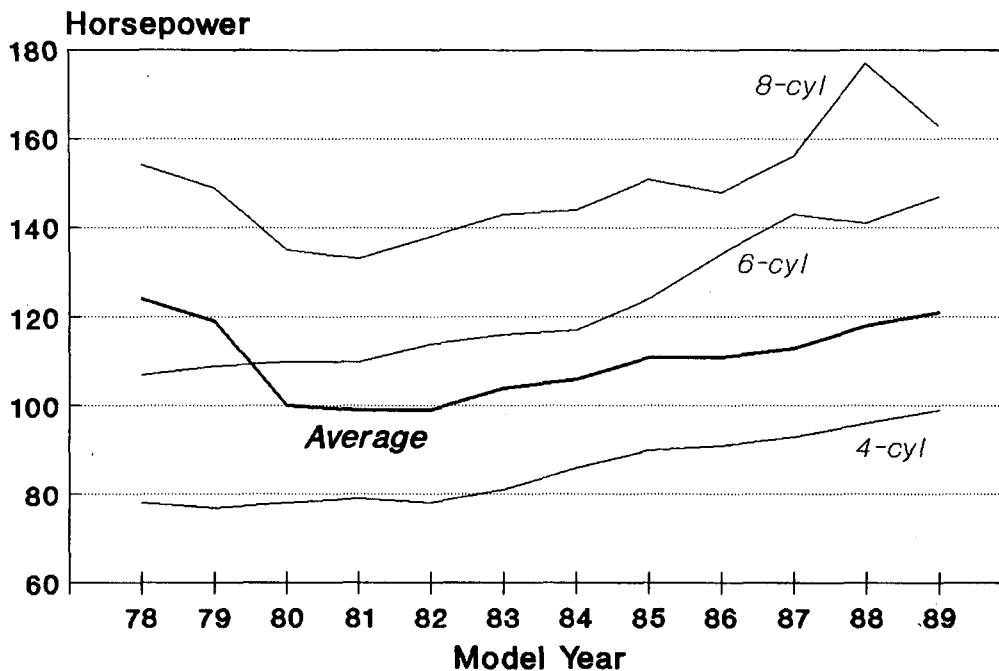


Fig. 9

Average Zero to 60 Acceleration Passenger Cars

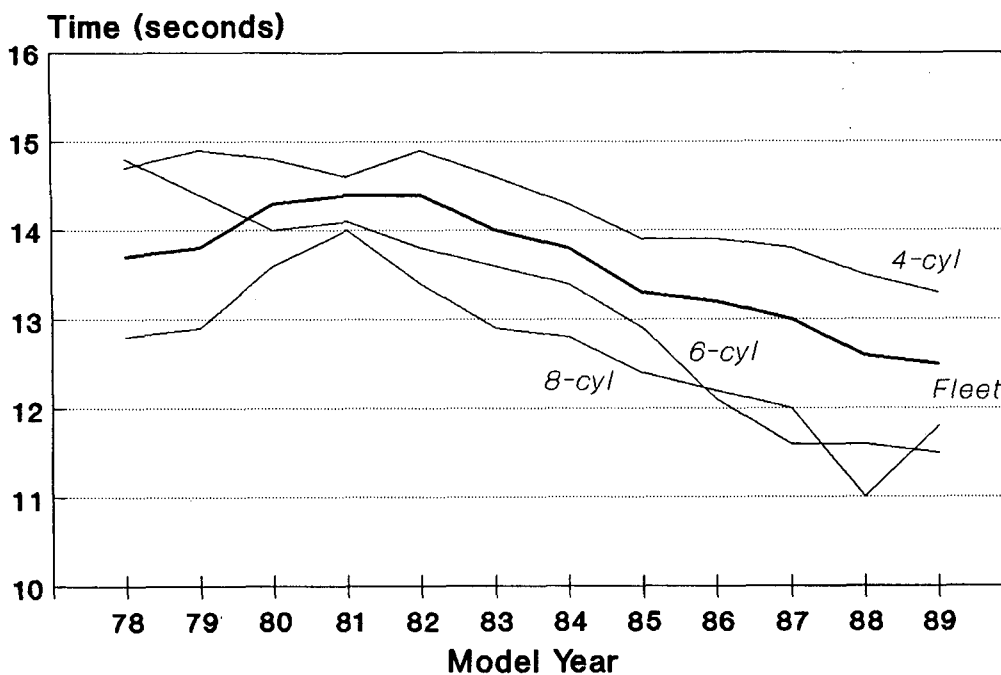


Fig. 10

Car Fuel Metering by Number of Cylinders

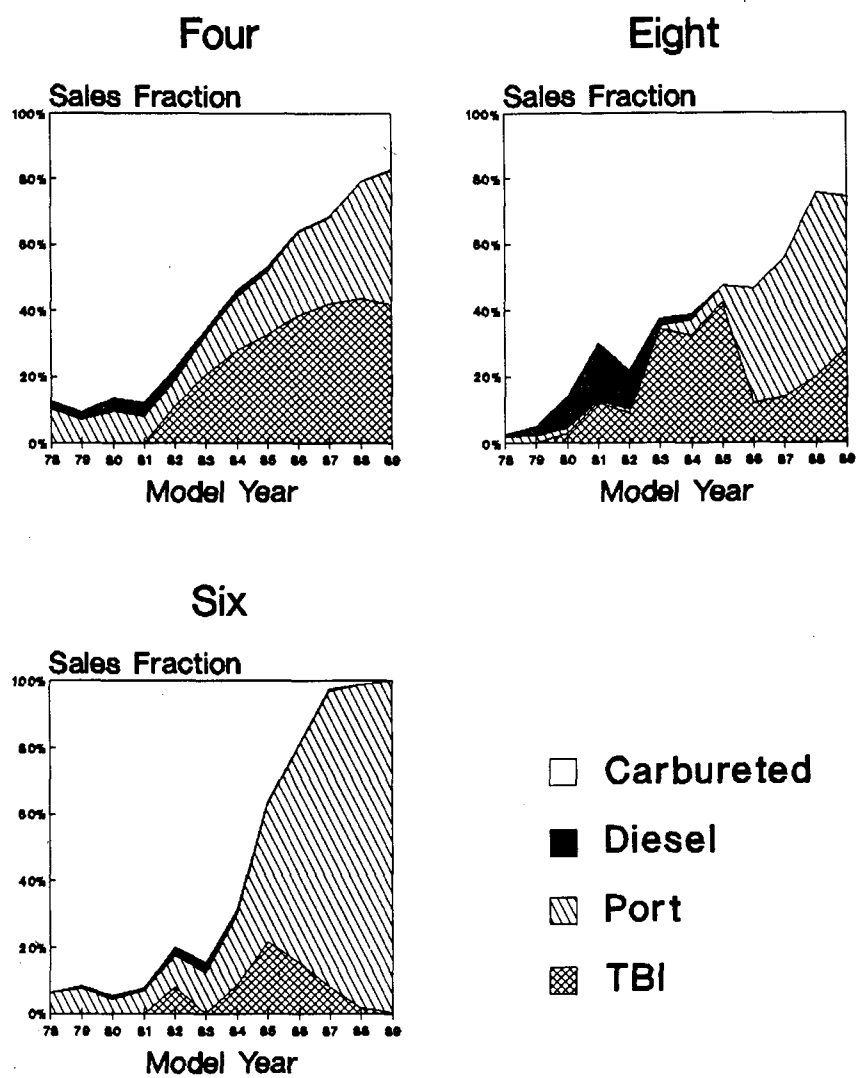


Fig. 11

VI. Trends by Vehicle Size

A. Vehicle Size Class

Table 10 describes cars by EPA car class. Only Minicompacts and Small Wagons show any significant variation in interior volume: Minicompact volumes have ranged from 73 to 83 cubic feet, Small Wagons 105 to 120 cubic feet. Note that interior volume is undefined for the Two-Seater car class; a value of 50 cubic feet has been assigned to all Two-Seaters, a class which has never accounted for more than about three percent of car sales.

On a class-by-class basis, passenger car MPG, inertia weight and engine size have changed very little the last several years, particularly for the four most sales significant classes (Subcompacts, Compacts, Midsize and Large sedans). MPG for Minicompacts dropped nearly 7 MPG since last year, but this class accounts for less than one-half of 1 percent of passenger car sales.

Aggregating the nine EPA classes into three groups, "Large Cars" (i.e. Large Sedans and Wagons), "Midsize Cars" (Midsize Sedans and Wagons) and "Small Cars" (Compacts, Subcompacts, Minicompacts, Small Wagon and Two Seaters), Table 11 gives major characteristics of these groups.

Since 1980, Large Sedans and Wagons have accounted for only 11 to 15 percent of the cars. By comparison, they accounted for about 20 percent of the cars in 1978 and 1979. Similarly, the market share of Midsize Cars and Wagons has dropped from a peak of 36 percent in 1981 to about one-fourth this year (see Figure 12).

Large Sedans and Wagons now achieve higher MPG than Small and Midsize cars did in 1978 and are lighter than Midsize Cars were then. Similarly, Midsize Cars achieve higher MPG than Small Cars did in 1978, but are heavier. At this level of stratification, there has been little change in MPG for several years.

More than 80 percent of the Small and Midsize cars now have front-wheel drive. Front-wheel drive usage for Large cars has now reached the 60 percent mark.

Use of TBI engines in Large cars peaked at 44 percent in 1985 and has since dropped to 15 percent, while use of port fuel injection increased. Similarly, usage of TBI engines in Midsize Cars peaked at 40 percent in 1986, dropping to 22 percent this year with port fuel injection increasing from 29 percent to 77 percent. Small car usage of TBI engines has remained in the 25-30 percent range the last five years, but small car usage of port fuel injection has increased to over 50 percent.

Table 10 - Fuel Economy, Market Fraction, CID, IW, 0 To 60, and Volume by Car Size Class

	Two Seater	Mini Compact	Sub Compact	Compact	Midsize Sedan	Large Sedan	Small Wagon	Midsize Wagon	Large Wagon
1978	19.4 .017 187	27.4 .081 120	24.6 .184 159	20.2 .133 236	18.6 .299 292	16.8 .183 357	24.3 .032 134	18.6 .045 258	15.9 .026 354
	3079 11.8 50	2584 14.1 79	2842 14.4 90	3552 14.5 105	3820 13.4 113	4394 12.8 128	2805 14.3 108	3836 14.4 140	4664 13.4 162
1979	20.1 .024 180	27.6 .040 113	24.1 .282 155	19.5 .062 246	19.1 .297 272	17.4 .196 339	25.7 .029 123	19.1 .045 249	16.1 .026 333
	3026 12.2 50	2450 14.4 80	2847 14.2 90	3624 14.4 105	3710 13.6 113	4210 12.9 130	2711 15.1 105	3758 14.7 140	4467 13.4 163
1980	20.6 .021 180	28.1 .041 116	27.1 .376 128	22.4 .073 186	21.6 .316 229	19.1 .102 314	28.6 .033 113	21.1 .027 228	19.1 .011 324
	2954 12.3 50	2459 14.4 83	2640 14.7 90	3185 14.4 106	3362 13.8 113	4130 14.0 131	2591 15.4 108	3535 15.0 140	4423 15.2 161
1981	21.9 .019 202	34.3 .026 92	29.3 .311 124	26.7 .112 142	22.9 .332 220	20.4 .109 304	30.0 .048 108	23.1 .031 193	19.9 .012 313
	3005 10.6 50	2164 14.5 83	2604 14.7 90	2825 14.2 104	3346 14.2 114	4108 14.3 131	2531 14.4 111	3285 14.5 136	4394 15.3 161
1982	25.7 .034 147	35.5 .023 95	29.1 .298 133	29.0 .162 128	24.0 .273 211	20.7 .106 292	30.6 .049 109	23.7 .036 205	19.2 .019 306
	2726 13.0 50	2193 14.6 83	2657 14.5 92	2794 14.6 103	3321 14.2 114	4034 13.9 131	2580 15.3 112	3384 14.3 136	4396 14.6 161
1983	23.9 .017 146	35.7 .020 100	30.0 .246 136	28.8 .182 141	23.9 .284 212	20.2 .135 293	32.2 .066 105	24.4 .034 200	19.6 .016 307
	2756 11.8 50	2273 14.2 82	2688 14.0 93	2844 14.4 103	3316 13.8 114	4041 13.4 131	2565 15.3 108	3348 14.1 136	4380 14.1 162

Table 10 - Fuel Economy, Market Fraction, CID, IW, 0 To 60 and Volume by Car Size Class (cont.)

	Two Seater	Mini Compact	Sub Compact	Compact	Midsi ze Sedan	Large Sedan	Small Wagon	Midsi ze Wagon	Large Wagon
1984	26.7 .033 174	25.6 .004 151	29.6 .238 140	29.7 .256 137	24.1 .260 210	20.5 .116 294	31.9 .043 107	25.0 .034 172	19.9 .017 305
	2886 12.1 50	2855 10.5 76	2737 13.5 93	2798 14.3 103	3318 13.6 114	4022 13.4 131	2620 15.2 116	3298 14.1 136	4371 13.9 162
1985	26.9 .031 158	36.0 .007 106	30.1 .202 136	29.8 .272 138	24.9 .258 205	22.3 .140 279	32.5 .046 107	25.0 .030 173	20.9 .014 305
	2826 11.7 50	2300 13.4 79	2734 13.4 94	2804 13.5 103	3319 13.3 114	3841 12.7 129	2579 15.2 118	3380 13.9 136	4354 13.2 162
1986	28.1 .028 166	30.7 .016 113	30.6 .216 136	29.8 .304 137	25.9 .242 194	23.9 .115 260	31.0 .032 113	26.0 .037 162	22.0 .011 304
	2916 11.7 50	2408 12.8 81	2764 13.4 95	2819 13.5 103	3241 13.0 114	3719 12.1 127	2648 14.7 118	3355 13.6 138	4381 13.9 161
1987	27.5 .026 167	30.7 .007 140	31.1 .193 128	29.7 .373 135	26.0 .211 189	23.8 .113 260	30.7 .033 116	25.6 .036 174	22.1 .008 304
	2920 11.5 50	2636 11.3 77	2728 13.7 93	2834 13.3 103	3250 12.7 114	3697 11.8 127	2795 14.2 120	3439 12.9 141	4348 14.0 162
1988	27.1 .020 169	31.2 .005 120	32.1 .195 123	29.8 .400 137	26.7 .194 184	24.3 .123 263	31.6 .025 112	25.8 .031 178	23.0 .008 305
	2967 10.9 50	2596 12.5 77	2681 13.3 93	2899 12.8 104	3289 12.3 113	3730 11.3 128	2733 13.8 117	3397 12.5 140	4310 13.2 162
1989	26.9 .015 184	24.5 .003 159	31.6 .196 122	29.9 .357 130	26.5 .228 183	24.2 .134 255	31.3 .024 112	25.7 .025 180	22.8 .018 306
	3011 10.4 50	2861 9.7 73	2716 13.0 94	2913 12.9 103	3329 12.3 114	3695 11.4 126	2897 13.7 119	3491 12.5 141	4413 14.2 161

Table 11 - Characteristics of Small, Midsize and Large Passenger Cars 1978 to 1989

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Small												
Sales(000)	4991	4714	5135	4495	4421	4248	6128	6030	6551	6836	6888	6122
Fraction	.447	.437	.544	.515	.565	.531	.574	.559	.595	.632	.646	.595
55/45 FE	23.3	23.4	26.2	28.6	29.2	29.8	29.6	30.0	30.1	30.1	30.5	30.4
Wt(lbs)	3013	2921	2709	2637	2675	2713	2765	2756	2784	2801	2825	2849
Ton-MPG	35.5	34.6	36.0	38.2	39.6	40.9	41.4	41.8	42.3	42.5	43.3	43.6
Disp(CI)	174	163	136	128	129	133	138	135	136	133	133	128
CID/Lb	.055	.053	.049	.047	.047	.048	.049	.048	.048	.047	.046	.044
% FWD	20.2	23.7	37.0	49.0	57.3	60.8	64.6	69.8	74.7	80.0	84.1	87.2
% Man.Tr	43.6	49.2	53.6	54.8	51.1	50.6	41.3	41.4	40.2	38.2	35.2	39.5
% Inject	10.1	8.9	10.5	11.4	18.4	33.2	44.9	52.9	60.9	66.7	80.1	83.2
% TBI					6.1	16.2	21.1	26.5	25.8	29.7	32.6	31.6
% Port	10.1	8.9	10.5	11.4	12.3	17.0	23.8	26.4	35.1	37.0	47.5	51.6
% Carb	88.6	89.0	85.6	83.8	77.8	64.7	52.9	45.8	38.7	33.1	19.9	16.7
% Diesel	1.4	2.1	3.9	4.8	3.8	2.1	2.1	1.3	.4	.2	.0	.1
Eng-Hp	99.2	96.6	85.5	84.7	85.7	89.0	94.2	98.6	99.8	101.0	106.2	108.2
Hp/CID	.631	.644	.659	.687	.684	.695	.707	.746	.753	.775	.815	.855
Hp/Lb	.033	.032	.031	.032	.032	.032	.034	.035	.035	.035	.037	.037
0 to 60	14.2	14.2	14.6	14.4	14.5	14.2	13.9	13.5	13.4	13.4	13.0	12.9
Midsize												
Sales(000)	3843	3693	3244	3175	2420	2544	3135	3103	3076	2663	2386	2604
Fraction	.344	.342	.344	.364	.310	.318	.294	.288	.279	.246	.224	.253
55/45 FE	18.6	19.1	21.6	23.0	24.0	24.0	24.2	24.9	25.9	25.9	26.6	26.4
Wt(lbs)	3822	3716	3376	3341	3329	3319	3315	3325	3256	3277	3304	3345
Ton-MPG	35.6	35.7	36.6	38.5	40.2	40.0	40.3	41.6	42.3	42.6	44.1	44.3
Disp(CI)	288	269	228	218	211	211	205	201	190	187	183	183
CID/Lb	.075	.072	.067	.064	.062	.063	.061	.060	.058	.056	.055	.054
% FWD	1.2	4.5	27.8	32.5	42.8	47.1	56.8	63.1	72.5	78.7	87.5	82.0
% Man.Tr	2.2	2.4	8.0	6.2	2.6	1.7	1.5	1.6	2.8	1.9	4.3	7.6
% Inject	1.6	2.3	2.7	2.8	14.4	16.6	29.5	50.6	69.2	85.8	95.5	98.9
% TBI			1.4	2.1	13.6	15.3	25.0	36.6	40.4	39.8	27.2	21.7
% Port	1.6	2.3	1.3	.7	.8	1.3	4.5	14.0	28.8	46.0	68.3	77.2
% Carb	98.4	96.1	94.5	93.1	81.5	81.6	69.3	49.0	30.6	13.8	4.5	1.1
% Diesel	.0	1.6	2.8	4.1	4.1	1.7	1.2	.4	.2	.4		
Eng-Hp	133.4	126.4	112.3	107.1	107.5	111.2	112.6	116.8	118.0	124.0	128.3	131.5
Hp/CID	.467	.475	.510	.514	.532	.546	.571	.612	.650	.691	.716	.731
Hp/Lb	.035	.034	.033	.032	.032	.033	.034	.035	.036	.038	.039	.039
0 to 60	13.5	13.8	13.9	14.3	14.2	13.9	13.7	13.3	13.1	12.7	12.4	12.3
Large												
Sales(000)	2341	2387	1064	1064	978	1209	1412	1657	1388	1312	1387	1560
Fraction	.210	.221	.113	.122	.125	.151	.132	.154	.126	.121	.130	.152
55/45 FE	16.7	17.2	19.1	20.4	20.4	20.1	20.4	22.2	23.8	23.7	24.2	24.0
Wt(lbs)	4428	4240	4158	4137	4088	4077	4066	3886	3777	3741	3766	3780
Ton-MPG	37.2	36.7	40.1	42.8	42.2	41.1	41.6	43.1	44.8	44.3	45.7	45.4
Disp(CI)	357	339	315	305	294	294	296	282	264	263	265	261
CID/Lb	.080	.080	.076	.074	.072	.072	.073	.072	.070	.070	.070	.069
% FWD	1.0							29.1	51.1	56.5	55.1	60.3
% Man.Tr									.6	.5	.4	.4
% Inject	.1	.1	1.8	15.3	17.1	35.9	37.3	60.9	76.2	81.0	85.8	84.3
% TBI			1.8	15.3	17.1	35.9	37.3	43.6	14.5	14.1	11.8	15.3
% Port	.1	.1						17.4	61.8	66.9	74.0	69.0
% Carb	98.5	96.8	86.2	68.4	72.8	61.5	61.8	38.8	23.8	19.0	14.2	15.7
% Diesel	1.4	3.1	12.0	16.3	10.1	2.7	.9	.3				
Eng-Hp	162.3	153.8	136.3	133.0	135.9	140.4	140.7	143.6	146.9	149.0	161.8	155.6
Hp/CID	.457	.456	.438	.442	.466	.480	.478	.511	.569	.579	.619	.617
Hp/Lb	.037	.036	.033	.032	.033	.034	.035	.037	.039	.040	.043	.042
0 to 60	12.9	13.0	14.2	14.4	14.0	13.5	13.4	12.8	12.2	12.0	11.4	11.7

Car Size Market Shares

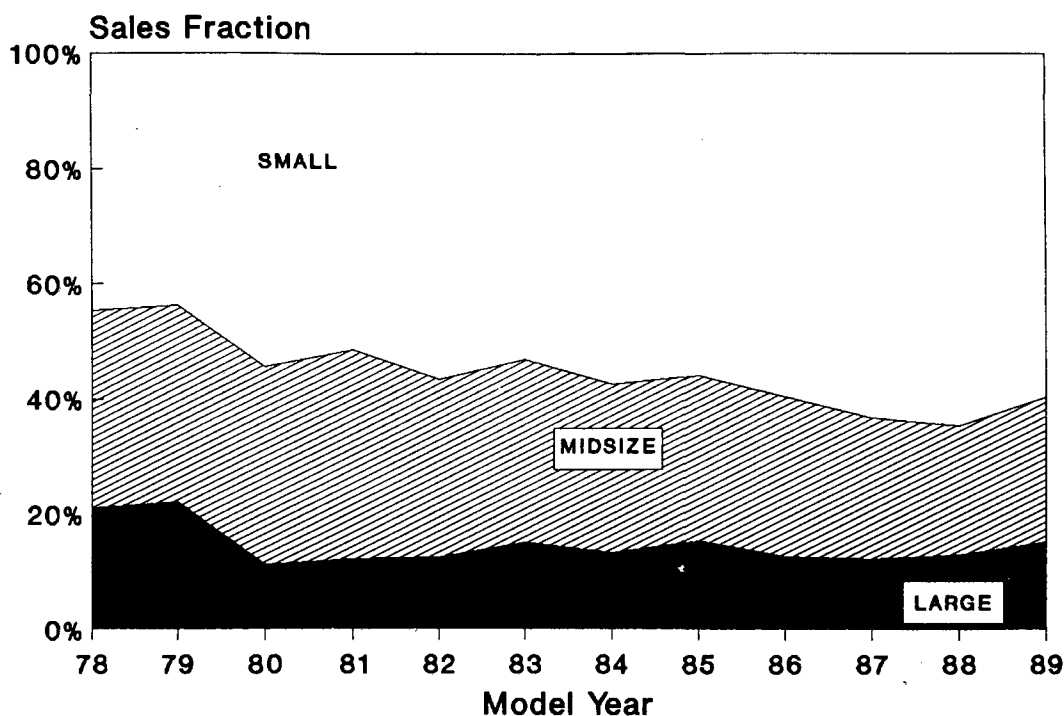


Fig. 12

Table 12 gives fuel economy, market fraction, CID and inertia weight for 1978 to 1989 light-duty trucks by size class. In 1978, Large Pickups accounted for nearly 60 percent of all light trucks; Large Vans 19 percent and Small Pickups 10 percent. Since then, the market share of Large Pickups has dropped to less than 30 percent (Figure 13). Small Pickups gained in popularity through 1983 when they accounted for 38 percent of all light trucks. Since then, their market share has dropped to about 20 percent while Small Vans and Utility Trucks have increased their shares of the market about 18 percent each.

The Light Truck fleet has improved 5.8 MPG since 1978, an amount larger than any of the classes due to mix shifts across classes. Inertia weight for five of the six size classes is higher this year than it was in 1978. The only exception is Large Pickups, which had an average inertia weight of 4,326 in 1978, compared to 4,252 this year.

Table 12 - Fuel Economy, Market Fraction, CID and Inertia Weight
for 1978 - 1989 Light-Duty Trucks by Size/Body Class

	Small Pickups	Large Pickups	Small Van	Large Van	Small Utility	Large Utility
1978	26.3 .1037 121 2844	14.7 .5889 339 4326	20.0 .0008 120 3500	14.2 .1902 330 4253	16.7 .0285 275 3026	13.8 .0878 359 4676
1979	23.4 .1486 123 2832	14.3 .5660 330 4486	18.7 .0027 120 3500	13.5 .1529 326 4560	16.7 .0339 261 3196	11.6 .0959 355 4975
1980	25.3 .2625 123 2792	17.4 .5083 294 4227	19.0 .0084 120 3619	16.5 .1213 299 4404	18.8 .0325 227 3083	14.3 .0670 328 4810
1981	28.1 .2468 129 2822	18.9 .5439 286 4069	18.5 .0062 120 3644	17.4 .1283 292 4357	20.4 .0234 225 3054	15.6 .0513 320 4734
1982	27.5 .3091 144 2880	19.0 .4438 287 4151	21.7 .0078 111 3668	17.1 .1545 296 4376	20.5 .0222 207 2922	16.8 .0626 324 4855
1983	26.9 .3805 145 2978	18.4 .3280 289 4197	19.7 .0062 118 3567	17.7 .1599 301 4445	21.9 .0680 189 3512	16.5 .0574 333 4905
1984	26.0 .2707 146 3080	18.8 .3402 271 4048	24.7 .0649 136 3380	17.1 .1371 303 4402	21.9 .1247 175 3546	15.5 .0622 331 4910
1985	25.9 .2273 151 3070	19.2 .3391 269 4026	23.5 .1206 169 3521	16.4 .1124 308 4462	22.1 .1429 168 3643	15.8 .0577 333 4945
1986	25.8 .2829 147 3118	19.7 .2992 262 4005	23.2 .1494 181 3671	17.4 .0906 305 4537	22.2 .1309 163 3550	16.3 .0470 328 4955
1987	26.8 .2610 147 3026	19.3 .2690 268 4091	23.3 .1788 186 3690	17.3 .0885 309 4539	22.4 .1594 175 3511	15.9 .0434 333 5068
1988	26.2 .2098 153 3062	19.0 .3284 285 4232	23.3 .1774 193 3809	17.9 .0783 313 4662	22.1 .1601 183 3530	16.3 .0461 336 5189
1989	25.1 .2135 163 3168	19.2 .2865 285 4252	23.3 .1859 186 3776	17.3 .0947 310 4664	21.7 .1789 201 3713	16.2 .0405 333 5036

Truck Class Market Shares

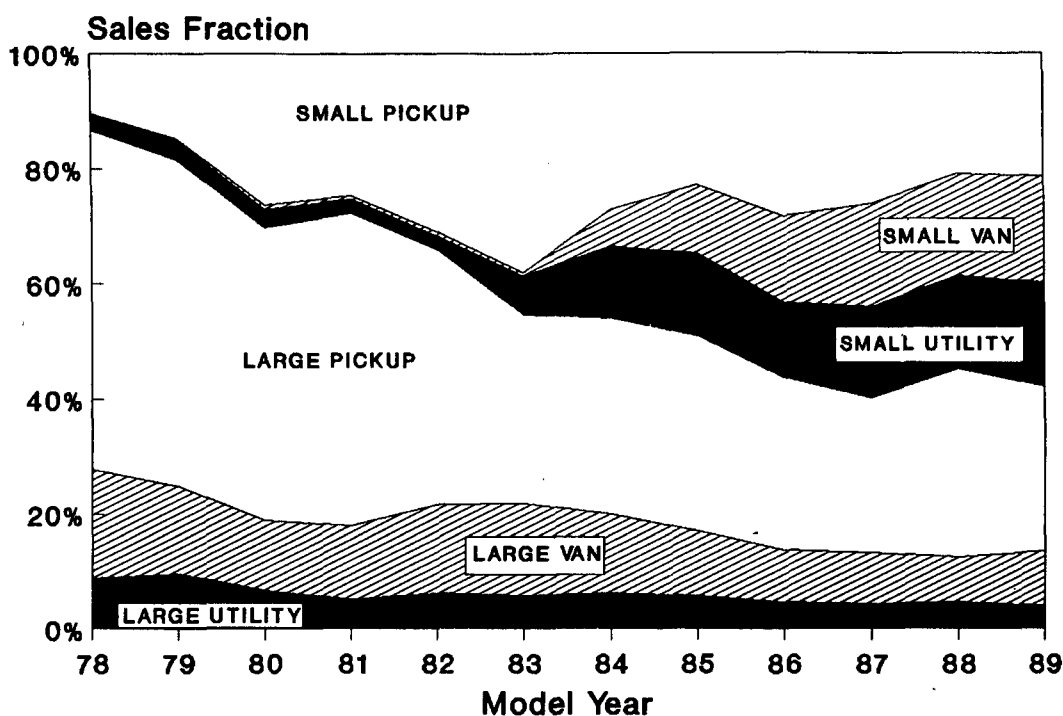


Fig. 13

B. Vehicle Weight Class

Table 13 presents fuel economy, market fraction, CID, 0 to 60 acceleration time and volume for 1978-88 cars by inertia weight. Table 1 showed that average interior volume of cars changed very little between 1978 and 1989, but inertia weight dropped nearly 500 lbs, with most of this decrease coming between 1978 and 1980. This shows up in Table 13 as an increase in volume by weight class. Analysis of cars with inertia weight above 4000 lbs is confounded by the fact that these vehicles accounted for more about a fourth of the cars built in 1978, compared to only about a percent or two of the cars built each year since 1984.

Since 1984, four weight classes, those from 2500 to 3500 lb, have accounted for over 70 percent of the cars built each year. Reduction in market share has occurred for those cars below 2500 lb and also for those above 3500 lb. Since last year, MPG has increased for all but two of the weight classes shown (3000 and 3500 lb), but these two classes account for over 50 percent of this year's production.

Table 14 presents fuel economy, average market fraction, and CID by inertia weight class for 1978 to 1989 light trucks. In 1978, two weight classes, 4000 and 4500 lb, accounted for 70 percent of the light trucks. The market share of these two classes dropped to about 40 percent in 1984-85, but have since increased by 49 percent.

The market share of the 3500 lb class for Light Trucks increased from 3 percent in 1978 to about 25 percent in 1986 where it has remained. Similarly, the 3000 lb class increased from 4 percent in 1978 to 20 percent in 1982, but has since dropped to 14 percent. At the inertia weight level of stratification, there has been no significant increase in fuel economy for seven years.

Table 13 - Fuel Economy, Market Fraction, CID, 0 to 60 Time, and Volume for 1978 to 1989 Passenger Cars by Inertia Weight Class

	Under 2250 -----	2250 -----	2500 -----	2750 -----	3000 -----	3500 -----	4000 -----	Over 4000 -----
1978	34.9 .024 90 14.3 80	31.9 .079 89 15.0 86	27.9 .070 101 15.1 92	24.8 .045 129 13.4 89	22.5 .081 164 13.9 97	20.2 .268 257 13.8 111	18.0 .200 306 13.1 115	15.8 .233 369 13.1 126
1979	32.0 .022 88 14.4 80	31.4 .065 88 15.2 88	27.9 .100 101 15.4 91	24.0 .043 132 13.6 82	22.1 .119 162 13.9 96	20.2 .249 252 13.7 112	17.8 .245 311 13.0 120	16.2 .159 358 13.5 127
1980	33.0 .030 90 14.3 86	32.4 .123 92 15.0 90	28.0 .124 104 15.6 92	26.1 .103 142 13.6 96	23.6 .215 164 13.8 101	20.7 .227 244 14.1 111	18.8 .139 302 13.9 122	18.9 .039 350 15.1 137
1981	38.4 .024 86 14.0 87	34.4 .136 96 14.8 91	29.4 .175 108 14.8 95	27.7 .082 137 13.8 107	24.4 .186 165 13.8 104	22.2 .209 234 14.3 113	20.3 .150 296 14.0 123	20.3 .037 343 16.1 137
1982	40.3 .020 86 14.5 87	35.6 .113 94 15.0 92	31.2 .184 106 15.4 92	28.8 .123 124 14.4 104	25.7 .199 163 13.6 104	22.4 .182 237 14.0 112	20.6 .155 287 13.8 126	20.7 .024 323 16.1 148
1983	43.6 .012 84 14.4 86	36.2 .123 95 14.9 96	32.2 .155 107 15.0 95	30.2 .108 124 14.2 106	25.8 .189 161 13.4 105	22.8 .209 238 13.6 112	20.3 .181 287 13.4 127	19.8 .024 312 14.4 146
1984	44.3 .009 86 13.5 73	37.1 .084 94 14.8 97	32.7 .143 107 14.7 96	30.1 .192 127 14.1 103	26.4 .187 157 13.2 105	22.9 .208 236 13.1 110	20.6 .159 289 13.4 126	20.0 .018 309 14.0 152
1985	48.5 .009 78 14.5 68	37.5 .078 94 14.6 97	32.8 .157 109 14.2 98	30.6 .174 128 13.6 103	27.1 .189 153 13.0 106	23.4 .228 228 12.7 112	21.7 .155 294 12.8 125	20.8 .010 307 13.8 160
1986	45.8 .013 67 15.9 79	38.5 .068 93 14.8 93	33.7 .147 106 14.3 100	30.6 .172 125 13.4 102	27.5 .257 151 13.2 107	24.4 .251 225 12.0 113	22.1 .083 299 12.4 125	21.2 .009 309 14.0 156
1987	43.4 .013 68 16.0 81	39.0 .043 91 14.6 90	33.4 .183 104 14.6 99	30.8 .175 124 13.3 102	27.9 .258 147 12.9 106	24.6 .236 218 11.6 114	21.7 .084 295 12.3 122	22.0 .007 307 14.5 159
1988	44.5 .019 71 15.3 89	39.4 .039 91 13.5 91	34.1 .159 100 14.4 100	31.4 .145 122 13.1 102	28.5 .296 145 12.6 105	25.4 .253 213 11.3 114	22.4 .079 290 11.2 126	22.4 .010 308 14.4 144
1989	46.4 .020 74 14.8 92	40.1 .025 89 13.4 94	35.0 .153 98 13.9 99	31.8 .115 119 13.1 102	28.1 .300 147 12.4 106	25.2 .274 199 11.4 114	23.1 .089 267 12.4 123	22.4 .023 308 14.4 148

Table 14 - Fuel Economy, Market Fraction and CID
for 1978 to 1989 Light Trucks by Inertia Weight Class

	Under 2750 -----	2750 -----	3000 -----	3500 -----	4000 -----	4500 -----	5000 -----	Over 5000 -----
1978	27.2 .007 97	23.5 .074 157	25.2 .044 148	18.6 .031 267	15.9 .402 319	13.5 .301 353	12.8 .099 371	12.1 .042 379
1979	27.5 .013 96	22.6 .081 126	21.9 .073 154	16.9 .022 251	15.9 .227 301	13.9 .311 323	12.3 .218 363	11.0 .054 401
1980	28.8 .024 92	25.2 .174 126	22.7 .114 146	18.3 .044 211	18.6 .288 279	15.7 .209 319	15.1 .130 347	13.0 .018 355
1981	33.3 .028 102	27.9 .122 130	25.9 .137 150	20.9 .067 238	19.1 .371 283	16.8 .205 312	15.8 .067 330	13.7 .003 350
1982	29.8 .026 120	28.3 .119 130	25.9 .198 162	22.1 .076 205	18.7 .256 286	16.8 .213 310	17.0 .089 332	21.5 .024 350
1983	28.1 .017 126	28.8 .148 132	25.7 .180 158	23.3 .120 174	19.0 .218 269	17.0 .225 310	17.0 .075 332	20.4 .017 374
1984	28.0 .007 99	28.3 .098 130	26.0 .172 153	22.7 .221 164	18.9 .206 265	16.7 .207 310	16.0 .078 327	18.2 .012 369
1985	29.1 .003 82	29.9 .067 130	26.2 .179 151	23.0 .260 168	19.6 .202 260	16.4 .203 311	15.9 .076 326	17.1 .010 363
1986	32.7 .010 84	29.5 .073 132	26.8 .193 143	23.0 .259 164	20.1 .215 243	17.3 .177 307	16.3 .067 323	16.8 .008 348
1987	33.0 .015 81	29.7 .057 133	26.9 .187 144	23.0 .287 178	20.6 .223 236	17.2 .163 314	15.9 .055 327	16.9 .014 352
1988	33.3 .018 81	27.7 .030 134	27.1 .149 148	22.7 .242 188	21.3 .250 223	18.0 .218 320	16.2 .074 326	16.9 .019 352
1989	32.2 .011 91	27.7 .022 135	26.7 .135 146	22.7 .241 188	21.5 .290 220	17.8 .200 318	16.4 .094 328	16.6 .007 355

VII. Trends by Market Segment

Table 15 shows major characteristics of the Domestic, European, and Asian car fleets for model years 1978-89. Table 16 presents similar data for light trucks, but the truck fleet is divided into just Domestic and Import segments. As in previous papers, Import production volumes include vehicles assembled in the U.S. by foreign manufacturers.

A. Market Share

As shown in Figure 14, the market share of European cars has stayed at 5 to 7 percent. The Asian share of the car market, on the other hand, has increased from 14 percent in 1978 to over 33 percent. Sales of Import trucks have ranged from 10 to 30 percent. Their share of the light truck market this year (20 percent) is much lower than it was two years ago when 30 percent of Light Trucks were Imports.

B. Vehicle Size

Domestic cars built this year are 523 pounds lighter than their 1978 counterparts, have engines that are 93 CID smaller and get 8.1 higher MPG. Nearly 70 percent of this MPG increase occurred between 1978 and 1982.

This year's Asian and European cars get higher MPG than in 1978, but are heavier and have larger engines. European passenger car MPG peaked at nearly 30 MPG in 1981, primarily because Diesel engines were used in 36 percent of the European cars that year.

Sales Fraction by Vehicle Type Cars and Light Trucks

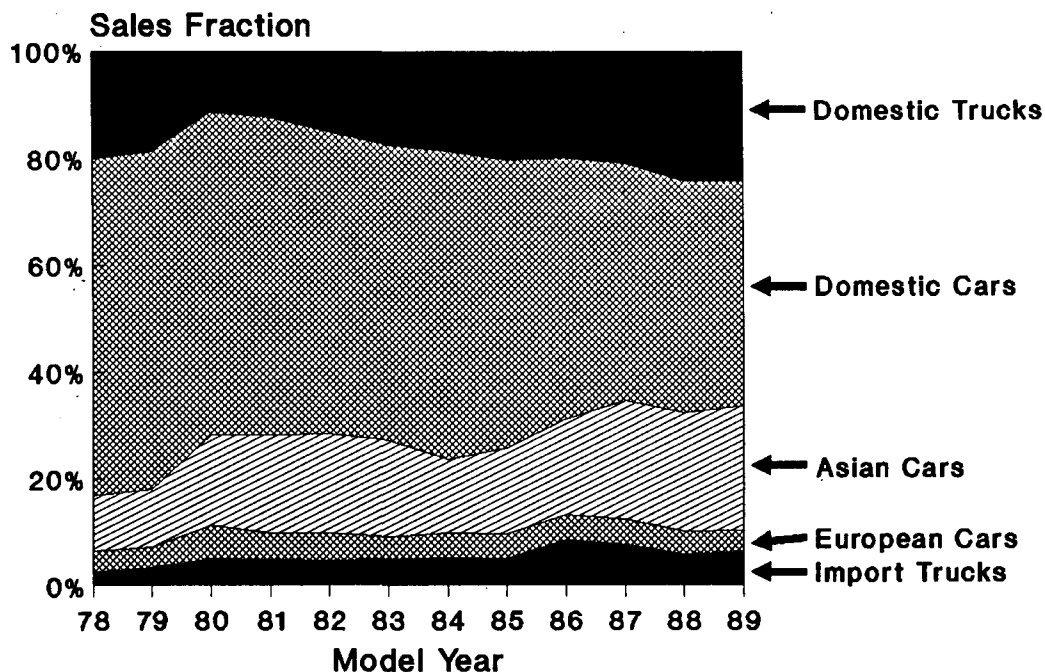


Fig. 14

Table 15 - Characteristics of 1978 to 1989 Domestic, European and Asian Passenger Cars

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	----	----	----	----	----	----	----	----	----	----	----	----
Domestic												
Sales(000)	9084	8761	6820	6261	5506	5682	8102	7797	7515	6702	6616	6233
Fraction	.813	.812	.722	.717	.704	.710	.759	.723	.682	.620	.621	.606
55/45 FE	18.7	19.3	21.9	23.5	24.5	24.1	25.1	25.8	26.6	26.6	27.2	26.8
Wt(Lbs)	3828	3696	3323	3291	3247	3310	3233	3246	3199	3202	3247	3305
Ton-MPG	36.0	35.7	36.5	38.7	40.0	40.2	40.8	41.9	42.6	42.7	44.2	44.4
Disp(CI)	284	268	218	210	200	208	197	199	191	189	190	191
CID/Lb	.073	.071	.064	.062	.059	.061	.059	.059	.058	.058	.057	.057
% FWD	4.6	6.3	23.4	32.4	42.9	42.5	51.3	60.0	68.2	74.0	78.5	79.8
% 4WD			.6	.3	.4	.6	.3	.0	.1	.6	.4	.3
% Man.Tr	8.2	9.9	16.8	15.3	15.4	12.3	13.6	11.0	11.7	10.7	9.9	10.8
% Inject	1.1	1.1	1.2	3.7	13.9	27.3	38.3	57.5	70.7	84.9	95.4	95.6
% TBI			.9	3.7	13.9	26.6	32.0	44.2	41.0	44.6	35.0	32.9
% Port	1.1	1.1	.2			.7	6.3	13.3	29.6	40.4	60.4	62.7
% Carb	98.6	97.3	95.7	91.3	82.4	71.5	60.7	42.3	29.2	15.0	4.6	4.4
% Diesel	.4	1.6	3.1	5.0	3.7	1.2	.9	.2	.1	.1		
Eng-Hp	133	128	109	106	106	111	110	117	117	121	129	131
Hp/CID	.483	.501	.532	.549	.567	.565	.593	.625	.646	.666	.704	.710
Hp/Lb	.035	.035	.033	.032	.032	.033	.034	.036	.036	.037	.039	.039
0 to 60	13.6	13.6	14.1	14.2	14.3	14.0	13.8	13.2	13.0	12.8	12.3	12.3
% Small	32.2	31.0	37.3	32.7	38.8	34.7	45.3	40.7	43.6	43.3	47.7	38.5
% Mid	42.1	41.8	47.1	50.3	43.4	44.1	37.2	38.0	38.1	37.4	31.6	36.8
% Large	25.8	27.2	15.6	17.0	17.8	21.3	17.4	21.3	18.3	19.4	20.7	24.8
Cu.Ft	114	114	110	113	112	115	111	113	112	112	113	114
Cu.Ft MPG	2185	2235	2448	2706	2800	2828	2857	2950	2999	3017	3079	3086
Cu.Ft Ton MPG	4117	4088	4048	4408	4504	4612	4553	4734	4768	4805	4982	5085
European												
Sales(000)	582	520	699	525	494	441	640	666	735	745	643	593
Fraction	.052	.048	.074	.060	.063	.055	.060	.062	.067	.069	.060	.058
55/45 FE	23.9	24.4	28.0	29.4	28.6	27.2	26.7	26.3	26.0	25.9	25.6	24.6
Wt(Lbs)	2705	2783	2649	2765	2895	3041	2987	3070	3019	3025	3091	3227
Ton-MPG	33.2	35.1	38.5	42.1	42.7	42.0	40.8	41.1	39.8	39.5	39.9	40.1
Disp(CI)	115	121	114	121	129	140	139	144	146	146	147	155
CID/Lb	.042	.043	.043	.044	.044	.046	.046	.046	.047	.047	.046	.047
% FWD	53.7	47.0	65.3	61.1	54.8	41.9	45.4	45.0	47.0	45.6	48.9	40.6
% 4WD						.1	.5	.6	1.2	1.4	1.3	1.7
% Man.Tr	68.6	69.1	75.2	68.7	61.2	53.5	51.0	46.4	46.9	48.7	44.7	37.2
% Inject	65.5	54.9	55.3	61.4	65.6	77.0	84.2	88.8	91.4	90.3	94.1	99.5
% TBI												
% Port	65.5	54.9	55.3	61.4	65.6	77.0	84.2	88.8	91.4	90.3	94.1	99.5
% Carb	22.9	27.5	15.5	2.2	6.3	3.6	2.2	.3	5.3	6.6	5.8	
% Diesel	11.5	17.6	29.2	36.4	28.1	19.4	13.6	10.9	3.3	3.1	.1	.5
Eng-Hp	87	87	80	84	92	107	110	117	124	128	134	145
Hp/CID	.758	.727	.702	.694	.718	.773	.798	.827	.857	.885	.918	.948
Hp/Lb	.032	.031	.030	.030	.031	.035	.037	.038	.040	.041	.042	.044
0 to 60	14.7	15.1	15.4	15.2	14.8	13.5	13.0	12.8	12.2	11.9	11.7	11.3
% Small	96.2	93.4	95.4	95.0	93.8	90.5	81.6	79.5	76.3	78.5	73.6	73.7
% Mid	3.8	6.6	4.6	5.0	6.2	9.3	18.4	20.5	22.3	19.6	24.2	23.7
% Large						.1		.0	1.5	1.8	2.2	2.7
Cu.Ft	92	90	90	93	96	99	100	102	103	101	101	103
Cu.Ft MPG	2335	2354	2699	2928	2923	2784	2772	2818	2788	2701	2684	2615
Cu.Ft Ton MPG	3084	3195	3498	3940	4144	4180	4086	4231	4124	4012	4068	4152

Table 15 - Characteristics of 1978 to 1989 Domestic, European and Asian Passenger Cars (continued)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	----	----	----	----	----	----	----	----	----	----	----	----
Asian												
Sales(000)	1510	1513	1924	1948	1819	1879	1933	2328	2765	3364	3401	3461
Fraction	.135	.140	.204	.223	.233	.235	.181	.216	.251	.311	.319	.336
55/45 FE	28.7	26.7	29.0	30.9	31.2	32.7	32.7	32.2	32.9	32.1	32.6	31.9
Wt(Lbs)	2482	2506	2482	2469	2512	2529	2569	2585	2616	2696	2675	2756
Ton-MPG	36.2	33.9	36.4	38.6	39.7	41.9	42.5	42.2	43.5	43.6	43.9	44.2
Disp(CI)	106	107	107	109	113	112	114	113	110	111	109	111
CID/Lb	.042	.042	.043	.044	.044	.044	.044	.043	.042	.041	.040	.040
% FWD	22.8	32.4	39.2	45.5	51.3	63.2	66.8	71.8	85.3	89.2	92.2	92.6
% 4WD		2.5	2.4	2.1	2.2	11.3	4.2	9.4	3.6	3.1	3.1	3.0
% Man.Tr	74.1	77.8	69.7	68.7	64.4	67.1	59.4	59.0	54.4	47.3	46.9	49.9
% Inject	5.9	8.1	9.4	11.0	13.1	20.2	29.1	29.9	43.2	45.8	61.0	70.4
% TBI							.5	.4	1.7	8.5	21.8	19.9
% Port	5.9	8.1	9.4	11.0	13.1	20.2	28.6	29.5	41.4	37.3	39.1	50.6
% Carb	94.1	91.9	90.6	88.2	85.6	79.3	70.1	69.9	56.8	54.2	39.0	29.6
% Diesel				.8	1.3	.5	.8	.2	.1			
Eng-Hp	84	78	77	78	80	83	88	89	90	93	95	100
Hp/CID	.784	.734	.720	.713	.707	.731	.768	.782	.810	.826	.862	.899
Hp/Lb	.033	.031	.031	.031	.032	.032	.034	.034	.034	.034	.035	.036
0 to 60	14.0	14.6	14.6	14.5	14.5	14.2	13.7	13.9	13.8	13.9	13.5	13.2
% Small	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.2	98.1	99.6	94.4	95.0
% Mid								.8	1.9	.4	5.6	5.0
% Large												
Cu.Ft	85	85	89	89	91	93	94	95	97	97	98	99
Cu.Ft MPG	2531	2356	2647	2816	2924	3160	3174	3175	3287	3198	3285	3244
Cu.Ft Ton MPG	3097	2895	3232	3426	3611	3924	4004	4013	4211	4236	4313	4377

Note the changes in MPG and 0 to 60 MPH acceleration time that have occurred between 1978 and 1989 for Domestic, European, and Asian cars. Between 1978 and 1981, average MPG for Domestic cars increased from 18.7 to 23.5 MPG while their acceleration increased from 13.6 to 14.2 seconds. Since then, Domestic MPG has increased to 26.8 and Domestic 0 to 60 acceleration time has decreased to 12.3 seconds.

European MPG and 0 to 60 acceleration time changed similarly between 1978 and 1981 when European MPG increased from 23.9 to 29.4. Since then, however, European MPG has decreased to 24.6 and European 0 to 60 acceleration time has decreased to 11.3 seconds. Between 1978 and 1983, 0 to 60 acceleration time for Asian cars remained above 14.0 seconds, but has since decreased to 13.2 seconds. In addition, Asian passenger car fuel economy has remained in a narrow (30.9 to 32.7) MPG range since 1981.

Import truck fuel economy peaked in 1981 at 27.3 MPG when 15.9 percent of them had Diesel engines (Table 16). Since then, import truck MPG has decreased 3.1 MPG and their inertia weight has increased 491 pounds.

Since 1978, Domestic light trucks improved 5.8 MPG, but almost all of this improvement occurred between 1978 and 1983. Since then, Domestic truck MPG and inertia weight have stayed in a narrow range.

Table 16 - Characteristics of 1978 to 1989 Domestic and Imported Light Duty Trucks

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
	----	----	----	----	----	----	----	----	----	----	----	----
Domestic												
Sales(000)	2915	2616	1293	1310	1459	1806	2608	2938	3055	3160	3705	3604
Fraction	.891	.847	.694	.720	.763	.785	.780	.801	.702	.734	.805	.793
55/45 FE	14.5	13.8	16.8	18.2	19.0	19.6	19.2	19.5	19.9	20.4	20.4	20.3
Wt(lbs)	4305	4504	4323	4173	4078	3977	3990	3963	3993	3945	4034	4051
Ton-MPG	31.8	31.8	36.8	38.4	39.3	39.6	38.9	39.2	40.1	40.6	41.5	41.4
Disp(CI)	337	330	303	293	277	257	250	245	243	240	250	251
CID/Lb	.079	.073	.070	.070	.068	.063	.062	.061	.060	.060	.061	.061
% FWD				.3	.0	.0	5.7	8.2	7.6	8.9	10.8	11.6
% 4WD	31.7	17.6	27.1	19.0	18.2	26.1	33.0	30.7	29.9	28.6	29.9	30.0
% Man.Tr	25.5	25.6	36.8	35.6	31.2	33.8	30.1	26.5	25.3	26.3	23.4	21.4
% Inject								9.5	44.6	80.3	96.4	98.5
% TBI								.2	19.8	36.5	50.8	52.1
% Port									24.8	43.8	45.6	46.4
% Carb	99.1	97.9	95.9	98.4	93.3	95.9	98.1	89.6	54.8	19.4	3.3	1.2
% Diesel	.9	2.1	4.1	1.6	6.7	4.1	1.9	.9	.6	.3	.3	.3
Eng-Hp	153	148	136	132	130	125	125	130	134	143	151	153
Hp/CID	.451	.449	.451	.453	.486	.508	.523	.553	.579	.620	.625	.632
Hp/Lb	.036	.033	.032	.032	.032	.031	.031	.033	.034	.036	.037	.038
0 to 60	13.2	14.2	14.4	14.4	14.3	14.5	14.6	14.2	13.8	13.0	12.7	12.6
% Small	2.7	3.8	4.3	3.3	18.1	33.8	39.3	45.9	49.1	50.8	48.7	50.6
% Large	97.3	96.2	95.7	96.7	81.9	66.2	60.7	54.1	50.9	49.2	51.3	49.4
Imports												
Sales(000)	358	473	571	510	454	495	737	730	1296	1146	899	942
Fraction	.109	.153	.306	.280	.237	.215	.220	.199	.298	.266	.195	.207
55/45 FE	25.1	23.1	24.3	27.3	27.1	27.1	26.6	26.3	26.1	25.6	24.5	24.2
Wt(lbs)	2903	2854	2839	2862	2932	2982	3045	3119	3136	3139	3228	3353
Ton-MPG	37.2	33.7	35.1	39.9	40.6	41.0	40.9	41.4	41.2	40.3	39.6	40.6
Disp(CI)	127	124	124	130	135	137	134	139	138	139	142	148
CID/Lb	.043	.043	.044	.045	.046	.046	.044	.045	.044	.044	.044	.044
% FWD			4.6	6.5	7.1	6.2	2.0	2.4	1.8	2.3	1.5	1.6
% 4WD	6.5	20.1	20.3	22.8	26.1	24.6	23.9	30.0	31.2	35.9	49.3	40.4
% Man.Tr	88.6	88.1	89.8	92.8	92.2	90.2	84.5	79.8	83.5	76.3	78.7	70.8
% Inject	.8	1.8	5.4	4.0	2.8	3.0	11.6	23.5	30.9	34.9	53.0	62.8
% TBI									16.1	20.5	19.8	20.9
% Port								.1	14.8	14.4	33.3	41.9
% Carb	99.2	98.2	92.6	80.1	79.5	90.3	84.6	74.9	68.0	64.9	47.0	37.2
% Diesel			2.0	15.9	17.7	6.8	3.8	1.6	1.1	.2		
Eng-Hp	89	85	87	84	87	92	91	100	99	99	105	110
Hp/CID	.719	.688	.701	.650	.648	.672	.680	.719	.717	.718	.741	.743
Hp/Lb	.031	.030	.031	.030	.030	.031	.030	.032	.032	.032	.033	.033
0 to 60	14.7	15.0	14.7	15.2	15.2	14.6	14.9	14.4	14.3	14.2	13.9	13.7
% Small	100.0	100.0	89.3	90.2	84.7	88.0	70.0	61.7	73.4	85.2	79.4	85.4
% Large			10.7	9.8	15.3	12.0	30.0	38.3	26.6	14.8	20.6	14.6

Since 1978, European and Asian cars have not only increased inertia weight and engine size, they have also increased their interior volumes by 11 and 14 cubic feet respectively (Figure 15). The size (interior volume) of Domestic cars has remained about the same (110 to 115 cubic feet) and their inertia weight has reduced.

Passenger Car Interior Volume, 1978 - 89

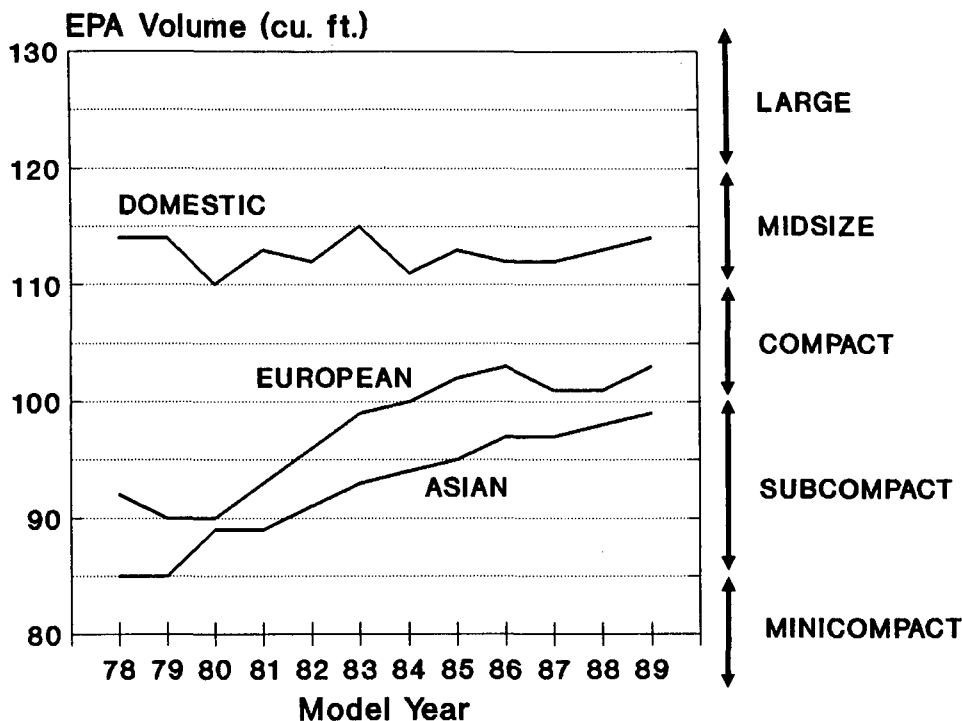


Fig. 15

Average interior volume for Domestic cars has remained in the "Midsize" range. Since 1978, average interior volume increased from the "Minicompact" to the "Subcompact" range for Asian cars, and from the "Subcompact" to the "Compact" range for European cars.

Table 15 showed two ratios, Hp/CID and HP/Wt, by which Domestic, European, and Asian cars can be compared. For the Domestics, Hp/CID has increased from 0.48 in 1978 to 0.71 this year. For the Europeans, Hp/CID dropped from a value of 0.76 in 1978 to 0.69 in 1981 (the peak year for European Diesel usage) and has since risen to a value of 0.95. Similarly, Hp/CID for the Asians decreased from 0.78 in 1978 to 0.71 in 1981 and 1982 and has since increased to 0.90 in 1989. Thus, Domestic cars, on a power per cubic inch displacement basis, trail the Imports.

From 1978 to 1982, horsepower per lb of inertia weight (Figure 16), remained in a relatively narrow range for Domestic, European, and Asian cars. Since then, this ratio has increased at roughly the same rate for European and Domestic cars and at a slightly slower rate for the Asians.

Horsepower per Pound, 1978 to 89

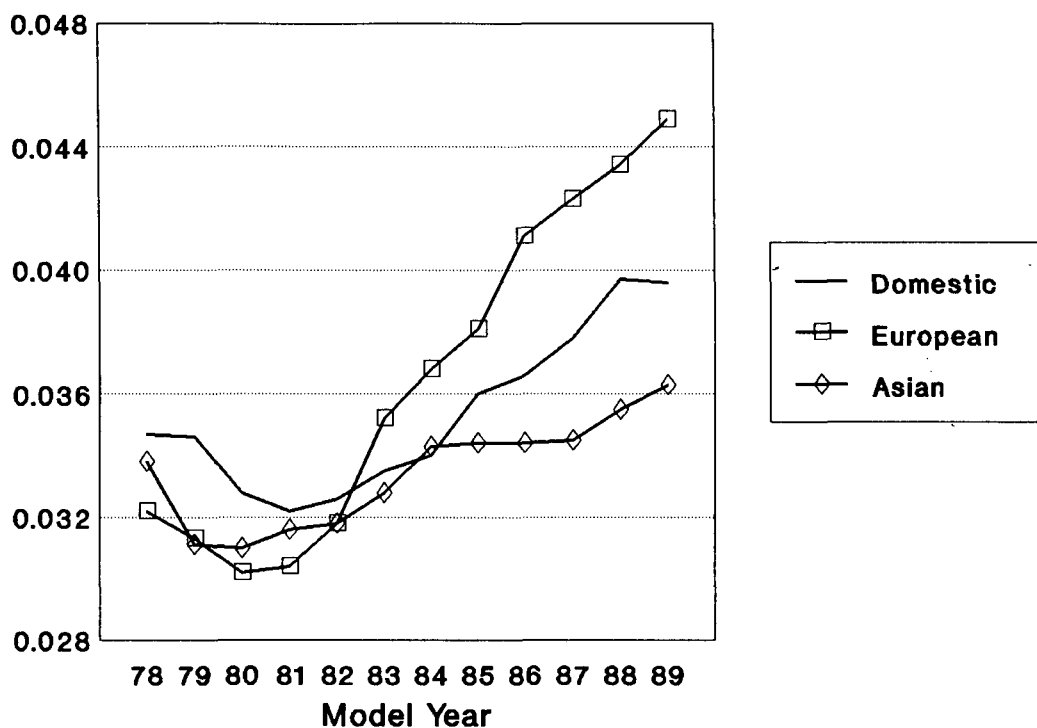


Fig. 16

Figure 17 shows the ratio of interior volume (in cubic feet) to inertia weight (in lbs). For the Domestic, interior volume has remained relatively constant, but because of the weight reductions which took place primarily between 1978 and 1982, this ratio increased.

For the Asians, interior volume and inertia weight have both consistently increased since 1978, but their ratio has remained relatively constant since 1979. Interior volume and inertia weight have increased on a similar basis for the Europeans through 1988. Since then, interior volume of European cars has remained constant, but their inertia weight has increased.

Cubic Feet per Pound, 1978 to 1989

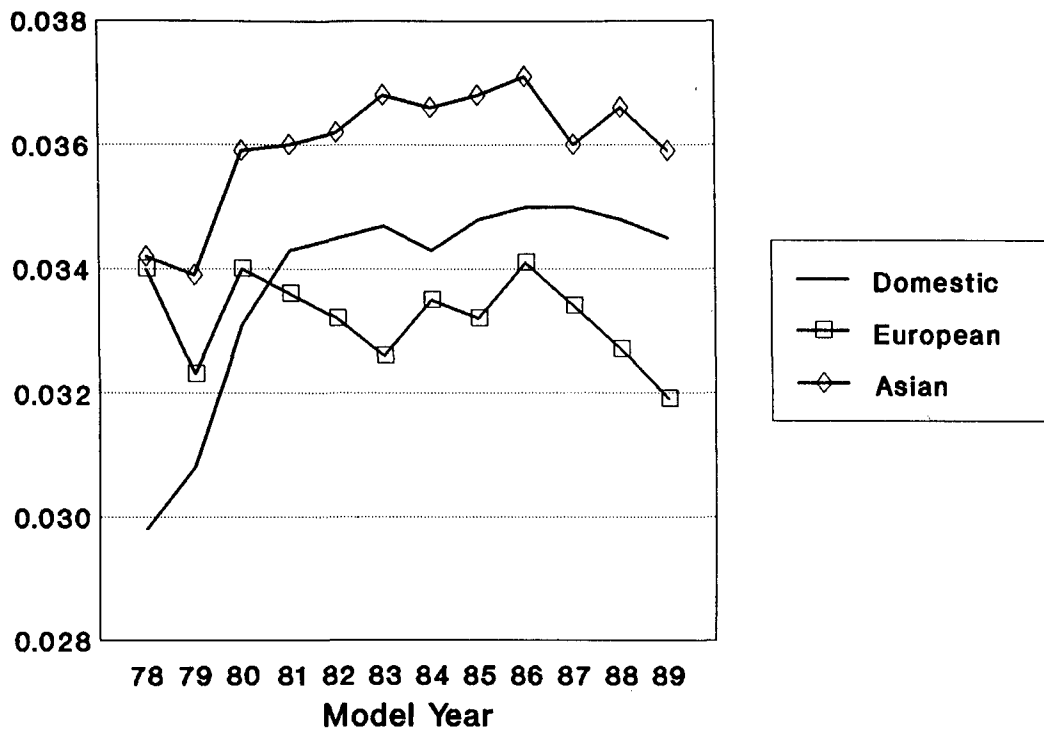


Fig. 17

Figure 18 shows ton-miles per gallon, i.e. miles per gallon multiplied by inertia weight in tons. Ton MPG equates vehicle utility with its ability to move weight (its own plus payload). Ton MPG for Domestic and Asian cars have both increased and are difficult to distinguish. Ton-MPG for European cars peaked in 1982 at 42.7 ton-MPG, dropped to a nominal value of 40 in 1986 where it has remained.

Cubic feet miles per gallon (Figure 19) is a metric which associates vehicle utility with the ability to move interior volume, i.e. passengers and cargo. Since interior volume of European cars has been constant, and European fuel economy has decreased the last few years, European cubic feet MPG has decreased. For the Asians, both interior volume and fuel economy have been relatively constant the last few years, thus so has their cubic feet MPG. Interior volume for the Domestic has also been constant, but their cubic feet MPG metric increased due to fuel economy increases.

Ton MPG, 1978 to 1989 Passenger Cars

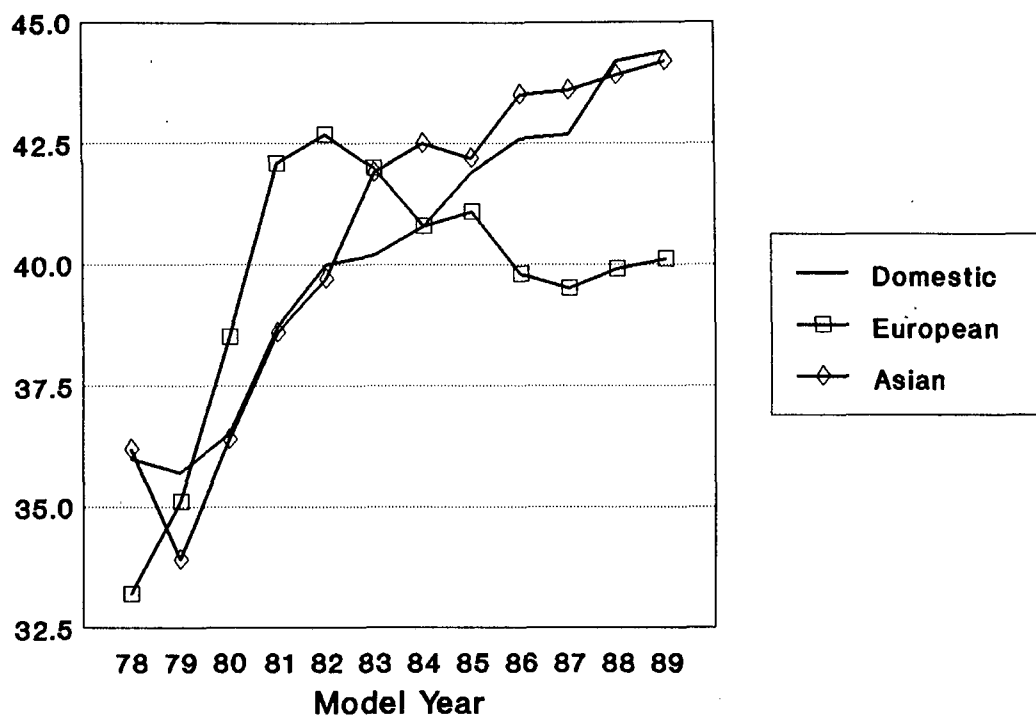


Fig. 18

Cubic Feet MPG, 1978 to 1989 Cars

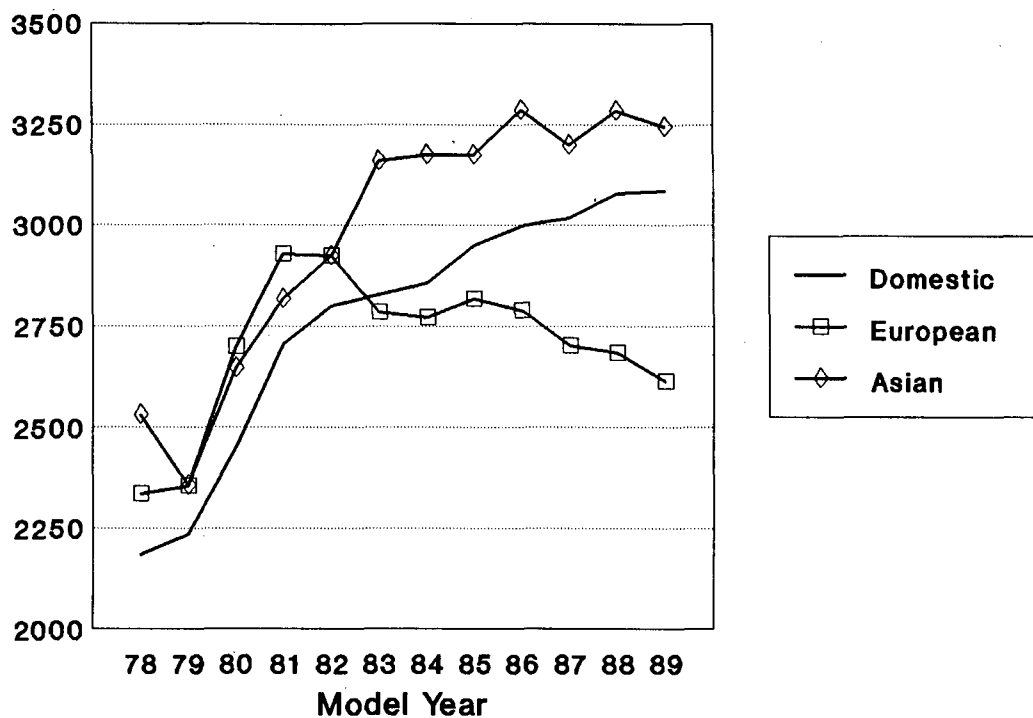


Fig. 19

C. Fuel Metering

Figure 20 shows the sales fractions of Domestic, European and Asian cars, which uses Diesel, carburetion, TBI or port fuel injection. Nearly all of this year's European cars use port fuel injection. Throttle body injection (TBI) has been used in only a small percentage of Asian cars. Less than 30 percent of the Asian cars still use carbureted engines.

Nearly two-thirds of this year's Domestic cars will use port-fuel injection. Use of TBI by the Domestic, however, remained relatively constant at about 43 percent for three years (1985 to 1987), but has dropped to 33 percent. Use of port fuel injection in Domestic cars has increased every year since 1983.

As mentioned earlier, fuel-injected engines are now used in more than 90 percent of this year's light trucks compared to less than 3 percent in 1984. Nearly all of this year's Domestic trucks are fuel injected, and over 62 percent of the Imports are. By comparison, fuel-injected engines were used in 45 percent of the 1986 Domestic and 31 percent of the 1986 Import trucks.

D. Drive and Transmission

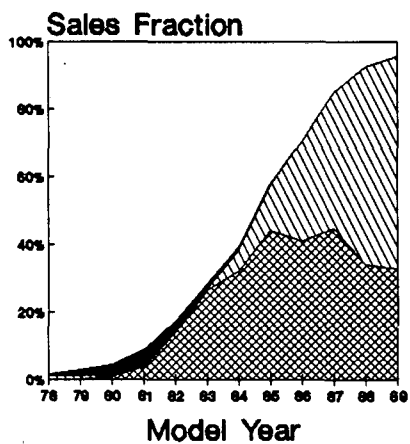
Nearly 80 percent of this year's Domestic cars will use front-wheel drive, as will more than 90 percent of the Asians compared to only 40 percent of the Europeans. Use of front-wheel drive in European cars peaked in 1980 at 65 percent.

Four-wheel drive has been used only in a small percentage of the Domestic, European, and Asian cars built each year. Four-wheel-drive usage for Domestic light trucks has varied from a minimum of 18 percent in 1982 to a maximum of 33 percent in 1984. For the Imports, on the other hand, four-wheel-drive usage has increased from 6.5 percent in 1978 to over 40 percent this year. Since 1985, front-wheel drive has been used in about 8-10 percent of the Domestic trucks and has been used in only as many as 7 percent (in 1982) of the Import trucks.

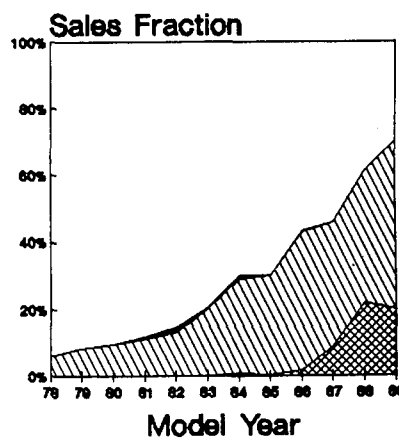
Use of manual transmissions in Asian cars has dropped from 78 percent in 1979 to about 50 percent the last four years. Similarly, use of manual transmissions peaked at 75 percent in 1980 for the Europeans and decreased to less than 40 percent this year. Manual transmission usage for Domestic cars increased from 8 percent in 1978 to 17 percent in 1980, and has remained in a 10 to 12 percent band since 1983.

Passenger Car Fuel Metering

Domestic



Asian



European

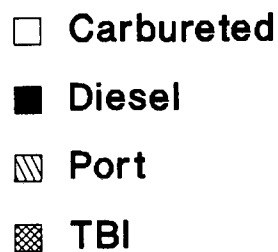
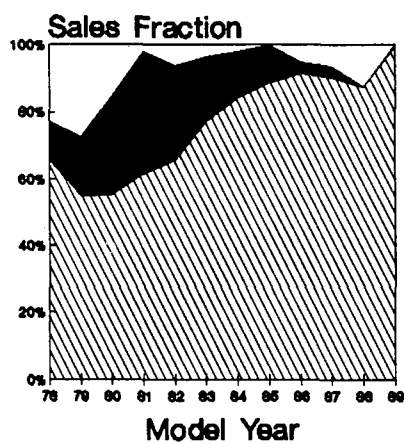


Fig. 20

VIII. Conclusions

Since 1982, there has been little improvement in the fuel economy of light-duty vehicles, compared to the improvements which took place before then: in the 7 years from 1975 to 1982, fuel economy improved by 10 MPG for passenger cars and 7 MPG for light trucks; in the 7 years from 1982 to 1989, fuel economy improved by 2 MPG for passenger cars and by 0.5 MPG for light trucks.

Average 55/45 MPG for cars decreased from 28.6 to 28.2 since last year. Other changes since last year include a 61 lb increase in inertia weight and increases in horsepower and engine size.

This year's Domestic light trucks get 5.8 MPG higher 55/45 fuel economy than their 1978 counterparts. Import light truck fuel economy has decreased 0.9 MPG since 1978.

This year's combined car and light truck fleet will average 25.5 MPG. Since 1981, 55/45 fuel economy improved 3.1 MPG for cars and 0.9 MPG for light trucks.

Average weight for cars was essentially constant (about 3100 lbs) for the past ten years, but seems to have started to increase in 1989.

Average weight for light trucks was essentially constant (about 3800 lbs) for the past ten years, but seems to have started to increase in 1989.

There is a hint of a trend toward lower fuel efficiency because of increases in vehicle weight, for both cars and trucks.

The market share of Large Sedans and Wagons has remained in a narrow range (11 to 15 percent) since 1980. The market share of Midsize Sedans and Wagons has dropped from 36 percent in 1981 to about 25 percent in 1987, where it remains.

Average inertia weights and fuel economy levels of the individual car size classes have changed very little since the early 1980s.

There is a trend toward smaller trucks. The market share of Large Pickups has dropped from 60 percent in 1978 to less than 30 percent this year, with Small Pickups, Vans, and Utility trucks absorbing the shift in market share. Light truck MPG has not changed significantly since 1981.

At the number of cylinders level of stratification, there has been little year-to-year improvement in fuel economy in the last several years for either cars or trucks. The market share of 6-cylinder engines has increased to over 30 percent for cars, and has increased to almost 50 percent for trucks. Compared to 1978, this year's 4-cylinder car engines are 11 CID larger, while 6- and 8-cylinder engines are smaller by 28 and 34 CID, respectively. Use of 8-cylinder engines has dropped to 10 percent of this year's cars and 25 percent of this year's trucks.

There is no trend toward larger displacement engines, but there is a consistent trend toward higher horsepower levels.

There is a trend toward lower fuel efficiency because increases in engine horsepower-to-CID capabilities are being used for performance increases, rather than for constant-performance CID reduction.

VIII. Conclusions (cont'd)

Fuel injection is used in more than 87 percent of this year's cars and 91 percent of the light trucks.

Since 1978, passenger car 55/45 fuel economy has improved 8.1 MPG for the Domestic models, compared to 0.7 MPG for European and 3.2 for Asian.

Sales of Asian cars are projected to exceed three million this year, more than double the number sold in 1978. The market share of European cars has been in a narrow range (5 to 7 percent) since 1978. The market share of Import trucks will be 21 percent this year, compared to a peak of 31 percent in 1980.

Since 1978, engine size, inertia weight, and interior volume have all increased for European and Asian cars. For the Domestics, interior volume has remained the same, but inertia weight and engine size have decreased since 1978.

The technical characteristics of recent model year cars are such that passenger car fleet fuel economy in the 30 to 34 MPG range can be achieved.

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Appendixes

APPENDIX A lists the vehicle classification convention used in this report.

APPENDIX B gives the sales-weighted average nameplate MPG values for model year 1988 cars and trucks, by size class.

APPENDIX C gives characteristics of model year 1989 cars by size class.

APPENDIX D gives characteristics of model year 1989 trucks by size class.

APPENDIX E gives characteristics of model year 1989 cars by weight class.

APPENDIX F gives characteristics of model year 1989 trucks by weight class.

Appendix A - Vehicle Classification Convention

Manufacturer/Vehicle	This Trend Analysis
AMC Renault Alliance	Domestic
AMC Eagle Medallion	European Import
AMC Eagle 4WD Car/Wagon	Car/Wagon
AMC Eagle Summit	Asian Import
Chrysler vehicles by Mitsubishi	Mitsubishi
Chrysler vehicles by Lamborghini	Lamborghini
Colt Vista by Mitsubishi	Mitsubishi Small Van
Mitsubishi Space Wagon	Small Van
Ford vehicles by Mazda	Mazda
Mercury Merkur and Scorpio	Ford European Import
GM vehicles by Isuzu	Isuzu
GM vehicles by Suzuki	Suzuki
1988-89 Pontiac LeMans	Asian Import
GM/Toyota vehicles	Asian Import
U.S. built Honda	Honda Import
Honda/Rover/Sterling	Asian Import
Subaru 4WD Car/Wagon	Car/Wagon
Subaru Brat	Small Pickup
U.S. built Volkswagen	VW Group
Audi and German built Volkswagen	VW Group
Porsche	VW Group through 1984, Porsche after 1984

Appendix B - Nameplate Average Fuel Economy

***** UNADJ TWO SEATERS 55/45 ***** MPG	***** UNADJ MINICOMPACT SEDANS 55/45 ***** MPG	***** UNADJ SUBCOMPACT SEDANS 55/45 ***** MPG
HONDA CIVIC CRX HF 60.7		SUZUKI METRO 65.3
		SUZUKI METRO LS1 51.1
		SUZUKI SPRINT 50.3
		DAIHATSU CHARADE E 46.4
		SUZUKI TURBO SWIFT 46.1
		SUZUKI TURBO SPRINT 46.1
		DAIHATSU CHARADE 45.1
		MAZDA FESTIVA 44.1
		SUBARU JUSTY 41.1
		SUZUKI SWIFT 40.8
		ISUZU SPECTRUM 39.6
		ISUZU I-MARK 39.6
		ISUZU SUNBURST 39.4
HONDA CIVIC CRX 38.1		TOYOTA TERCEL 38.0
		HONDA CIVIC 37.0
		NISSAN SENTRA HONEYBEE 36.9
		NISSAN SENTRA COUPE 36.7
		SUBARU JUSTY 4WD 36.1
		MERCEDES-BENZ 190D2.5 35.6
		NISSAN SENTRA 35.3
		HYUNDAI EXCEL 35.0
		NISSAN SENTRA COUPE 34.5
		NISSAN SENTRA COUPE 34.3
		MAZDA TRACER 34.2
		SUZUKI SWIFT GT1 34.0
		HONDA INTEGRA 32.1
		SUBARU HATCHBAC 31.7
		NISSAN PRIZM 31.6
		VW/AUDI FOX 31.5
TOYOTA MR2 31.4		NISSAN PULSAR NX 30.8
		TOYOTA COROLLA 30.5
SUBARU XT-DL 30.3		
BERTONE X1/9 29.2		
	VW/AUDI CABRIOLET 28.6	
		SUBARU XT 29.1
		CHRYSLER SUNDANCE CONVER 29.0
		GM SUNBIRD CONVERTIB 28.1
		TOYOTA CELICA 27.8
		HONDA PRELUDE 27.8
		CHRYSLER DAYTONA 27.8
ALFA ROMEO SPIDER 27.7		
		CHRYSLER SHADOW CONVERT 27.7
		VW/AUDI 80/90 26.6
		ISUZU IMPULSE 26.4
		GM CAVALIER CONVERTIB 26.3
		NISSAN 240SX 26.3
GM REATTA 25.5		CHRYSLER LEBARON CONVERTIB 25.5
	PORSCHE 944 TURBO 25.3	
		FORD MUSTANG 25.3
		SUBARU XT 4WD 25.1
	PORSCHE 944 24.8	SAAB 900 CONVERTIB 25.1
		MERCEDES-BENZ 190E2.6 24.7
LOTUS ESPRIT TU 24.3		
		GM CAMARO 23.9
		VW/AUDI 80/90 QUATTRO 23.9
		NISSAN 300ZX 2+2 23.9
		GM FIREBIRD/TRANS 23.9
		BMW M3 23.7
NISSAN 300ZX 23.5		
	PORSCHE 944 S 23.3	
		NISSAN 300ZX 23.4
		BMW 325I CONVERTIB 23.3
		NISSAN 300ZX 23.3
		ALFA ROMEO MILANO 23.2
		BMW 325IX 23.2
MASERATI TC BY MASERATI 23.1		
		BMW 325I/325IS 23.1
		TOYOTA SUPRA 23.0
GM CORVETTE 22.8		
GM CORVETTE CONVERTIB 22.8		
		MERCEDES-BENZ 300CE 22.8
MAZDA RX-7 88 22.7		
	PORSCHE 911 CARRERA 22.7	
MAZDA RX-7 22.2		
GM ALLANTE 20.4		
	VILLAGE IMPORTS 20.1	
	PORSCHE 928 S4 19.6	
	PORSCHE 911 TURBO 19.6	
MASERATI MASERATI KARIF 19.5		
	MASERATI MASERATI 225 19.5	
MASERATI SPYDER 19.5		
	MASERATI 222E 19.2	
	FERRARI 3.2 MONDIAL/CAB 17.2	
MERCEDES-BENZ 560SL 17.5		
FERRARI 328 GTS/GTB 17.2		
JAGUAR XJ-S CON 16.2		
FERRARI TESTAROSSA 13.4		
		MASERATI 430 19.3
		BMW 635CSI 18.9
LAMBORGHINI COUNTACH 8.7		
		JAGUAR XJ-S COUPE 16.7
		BMW M6 14.8
		ROLLS-ROYCE BENTLEY 12.1
		ROLLS-ROYCE CORNICHE II 12.1
		ASTON MARTIN LAGONDA 10.9
		ASTON MARTIN SALOON/VANTAGE 10.9

***** UNADJ
COMPACT SEDANS 55/45
***** MPG

TOYOTA COROLLA 36.4
NISSAN SENTRA 35.2
GM LEMANS 34.1
FORD ESCORT 34.0
MITSUBISHI SUMMIT 33.8
GM SKYHAWK 32.8
MAZDA 323 32.8
GM CAVALIER 32.1
VW/AUDI JETTA 31.9
CHRYSLER HORIZON 31.9
CHRYSLER OMNI 31.9
VW/AUDI GOLF 31.7
MAZDA LASER 31.1
HONDA ACCORD 31.0
GM SUNBIRD 31.0
GM GRAND AM 30.6

GM CUTLASS CALAIS 30.4
SUBARU SEDAN/3- 29.9
GM SKYLARK 29.9
MAZDA PROBE 29.2
CHRYSLER SHADOW 29.1
CHRYSLER SUNDANCE 29.0
MITSUBISHI GALANT 29.0
VW/AUDI JETTA GLI 16V 28.8
VW/AUDI GTI 16V 28.8

GM BERETTA 27.8
NISSAN STANZA 27.7

FORD TEMPO 27.6
FORD TOPAZ 27.5

TOYOTA CAMRY 27.0

CHRYSLER LEBARON 26.9

SAAB 900 26.4

PEUGEOT 405 SEDAN 25.7

NISSAN MAXIMA 25.3

MERCEDES-BENZ 260E 25.1
VOLVO 240DL/240GL.87 25.0

TOYOTA CRESSIDA 24.4
FORD TEMPO ALL WHEEL 24.4
FORD TOPAZ ALL WHEEL 24.4

PEUGEOT 505 SEDAN 23.5

FORD XR4Ti 23.4
BMW 525i 23.3

MITSUBISHI SIGMA 23.2
HONDA LEGEND 23.2
HONDA AUSTIN ROVER ST 23.1

MERCEDES-BENZ 300E 22.8

JAGUAR XJ6 22.6

VOLVO 780 21.1

MERCEDES-BENZ 300SE 20.9
BMW 535i 20.4

MERCEDES-BENZ 560SEC 17.3

***** UNADJ
MIDSIZE SEDANS 55/45
***** MPG

CHRYSLER RELIANT 30.5
CHRYSLER ARIES 30.5

GM CORSICA 28.8
GM 6000 28.7
MAZDA 626/MX-6 28.7
CHRYSLER CARAVELLE 28.5
CHRYSLER 600 28.5
GM CELEBRITY 28.4
GM CUTLASS CIERA 28.1

RENAULT MEDALLION SEDAN 27.7
GM CENTURY 27.6

CHRYSLER LANCER 27.4
CHRYSLER ACCLAIM 27.1
FORD TAURUS 27.1
FORD SABLE 27.1

CHRYSLER LEBARON GTS 27.0
GM REGAL 27.0
CHRYSLER SPIRIT 26.9

GM CUTLASS SUPREME 26.7
GM GRAND PRIX 26.4

HYUNDAI SONATA 26.3

GM TORONADO 25.5

GM RIVIERA 25.5

FORD COUGAR 25.3

FORD THUNDERBIRD 24.8
CHRYSLER DYNASTY 24.6

MAZDA 929 24.2
CHRYSLER NEW YORKER 24.0

VOLVO 740 23.9
VW/AUDI 100 QUATTRO 23.7
VW/AUDI 100 23.6

GM 6000 STE 4WD 23.4

VW/AUDI 200 23.3
VW/AUDI 200 QUATTRO 23.3
FORD MARK VII 23.2

GM ELDORADO 23.0
GM SEVILLE 23.0

FORD SCORPIO 22.6

VOLVO 760 21.4
CHRYSLER NEWPORT/FIFTH A 21.3

MERCEDES-BENZ 300SEL 20.9

BMW 735i 20.4
BMW 735iL 20.3
CHRYSLER GRAN FURY 19.4
MERCEDES-BENZ 420SEL 18.8
MASERATI 228 18.5
CHRYSLER DIPLOMAT 17.7

MERCEDES-BENZ 560SEL 17.3
BMW 750iL 16.6
ROLLS-ROYCE BENTLEY TURBO R 12.8
ROLLS-ROYCE SILVER SPIRIT 12.4
ROLLS-ROYCE BENTLEY EIGHT 12.4

***** UNADJ
LARGE SEDANS 55/45
***** MPG

SAAB 9000 25.7

GM EIGHTY-EIGHT 25.5

GM LESABRE 25.5
GM ELECTRA 25.5

GM NINETY-EIGHT/TOURING 25.3
GM BONNEVILLE 25.1

CHRYSLER PREMIER 24.8

CHRYSLER NEW YORKER 24.0

FORD CONTINENTAL 23.5

GM CAPRICE 23.3

FORD TOWN CAR 23.2
FORD GRAND MARQUIS 23.2

GM FLEETWOOD/DEVILLE 23.0

GM BROUGHAM 22.8

FORD LTD CROWN VICTORIA 22.1

ROLLS-ROYCE SILVER SPUR LIM .. 11.8

Appendix B - (Continued)

***** UNADJ
SMALL WAGONS 55/45
***** MPG

HONDA CIVIC 36.1
MITSUBISHI COLT 34.5
MITSUBISHI MIRAGE 34.4
NISSAN SENTRA 33.8
FORD ESCORT 33.5
MAZDA TRACER 32.9
GM SKYHAWK 32.7
MAZDA 323 32.1
GM CAVALIER 31.6
VW/AUDI FOX 31.3
SUBARU 30.9
HONDA CIVIC 4WD 30.1
TOYOTA CAMRY 29.8
NISSAN SENTRA 4WD 29.6
MITSUBISHI COLT 4WD 29.6
TOYOTA COROLLA ALL-TRAC 29.2
SUBARU 4WD 29.1

***** UNADJ
MIDSIZE WAGONS 55/45
***** MPG

GM 6000 28.1
GM CELEBRITY 27.8
GM CUTLASS CRUISER 27.1
GM CENTURY 26.9
RENAULT MEDALLION 26.9
VOLVO 240DL/240GL W87 26.9
FORD SABLE 26.3
FORD TAURUS 26.2
PEUGEOT 405 25.2
VOLVO 740 25.2
FORD TAURUS V6 24.6
FORD SABLE V6 24.6
VW/AUDI 100 23.6
PEUGEOT 505 23.4
VW/AUDI 200 QUATTRO 23.3

CHRYSLER TOWN & COUNTRY 22.5
MERCEDES-BENZ 300TE 21.8

***** UNADJ
LARGE WAGONS 55/45
***** MPG

FORD LTD CROWN VICTORIA 23.2
FORD GRAND MARQUIS 23.2
GM CUSTOM CRUISER 22.8
GM CAPRICE 22.8
GM SAFARI 22.8
GM LESABRE/ELECTRA 22.8

***** UNADJ
SMALL PICKUPS 55/45
***** MPG

MITSUBISHI TRUCK 2WD 27.7
MITSUBISHI RAM50 2WD 27.3
GM S15 PICKUP 2WD 26.9
GM S10 PICKUP 2WD 26.8
MAZDA B2200/B2600 26.7
MAZDA FORD COURIER 26.6
TOYOTA TRUCK 2WD 26.6
NISSAN TRUCK 2WD 26.2
ISUZU PICKUP 2WD 25.5
FORD RANGER PICKUP 2WD 25.2

FORD RANGER PICKUP 4WD 22.3

***** UNADJ
SMALL VANS 55/45
***** MPG

MITSUBISHI COLT VISTA 26.6
MITSUBISHI SPACE 26.3
TOYOTA VAN 2WD (PASSEN) 26.1
TOYOTA VAN 2WD (CARGO) 26.1
MITSUBISHI COLT VISTA 4WD 24.9
MITSUBISHI VAN 24.3
TOYOTA VAN 4WD (CARGO) 24.2
TOYOTA VAN 4WD (PASS) 24.1
CHRYSLER CARAVAN/RAM VAN 23.8
CHRYSLER VOYAGER 2WD 23.7
GM SAFARI 2WD (CARGO) 22.6
GM ASTRO 2WD (CARGO) 22.6
FORD AEROSTAR VAN 22.6
MITSUBISHI 22.3
GM SAFARI 2WD 22.3
GM ASTRO 2WD (PASS) 22.3

FORD AEROSTAR 22.0

VOLKSWAGEN VANAGON 2WD 21.1

AEROMATE 20.0

VOLKSWAGEN VANAGON SYNCRO 18.6

***** UNADJ
SMALL UTILITY 55/45
***** MPG

SUZUKI SAMURAI CONVERT 33.3
SUZUKI SAMURAI HARDTOP 33.3
SUZUKI TRACKER CONVERT 33.2
SUZUKI SIDEKICK CONVERT 32.2
SUZUKI TRACKER HARDTOP 30.3
SUZUKI SIDEKICK HARDTOP 29.7

MITSUBISHI SPACE 4WD 24.9

GM S15 JIMMY 2WD 23.4
MAZDA MPV 23.4
GM S10 BLAZER 2WD 23.4
ISUZU AMIGO 2WD 22.9

FORD BRONCO II 2WD 22.1
GM S10 BLAZER 4WD 22.1
GM S15 JIMMY 4WD 22.1

TOYOTA 4-RUNNER 4WD 21.9
CHRYSLER CHEROKEE 2WD 21.7
FORD BRONCO II 4WD 21.2

CHRYSLER WRANGLER 4WD 20.8
CHRYSLER CHEROKEE/WAGONE 20.8
ISUZU AMIGO 4WD 20.6
CHRYSLER WAGONEER LIMITE 20.0

MITSUBISHI MONTERO 19.9
MITSUBISHI RAIDER 19.9
ISUZU TROOPER 19.6
NISSAN PATHFINDER 2WD 19.3
NISSAN PATHFINDER 4WD 18.8

SHEBY DAKOTA 17.4
GM C1500 PICKUP 2WD 17.3
GM C1500 SIERRA 2WD 17.3
GM C2500 PICKUP 2WD 16.8
GM C2500 SIERRA 2WD 16.8

Appendix B - (Continued)

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***** UNADJ
LARGE PICKUPS 55/45
***** MPG

TOYOTA TRUCK 4WD 25.7
TOYOTA 1 TON TRUCK 24.5
GM COMMERCIAL CHAS 23.0
CHRYSLER COMANCHE PICKUP 22.8
GM COACHBUILDER WA 22.8
ISUZU PICKUP 2WD 1 TO 22.5
GM S10 PICKUP 4WD 22.4
GM S15 PICKUP 4WD 22.4
MITSUBISHI TRUCK 4WD 22.3

MITSUBISHI POWER RAM50 4WD ... 22.1
GRUMMAN-OLSON S10 CAB CHASSIS 21.8

CHRYSLER DAKOTA PICKUP 2 21.3

GM C1500 SIERRA 2WD 20.7
ISUZU PICKUP 4WD 20.6
GM C1500 PICKUP 2WD 20.6
NISSAN TRUCK 4WD 20.5
GM C2500 SIERRA 2WD 19.3
GM C2500 PICKUP 2WD 19.1
CHRYSLER DAKOTA PICKUP 4 18.7

CHRYSLER DAKOTA CAB CHAS 17.9
FORD F150 PICKUP 2WD 17.7

FORD F150 PICKUP 4WD 17.2

GM K2500 PICKUP 4WD 17.0
CHRYSLER D100/D150 PICKU 16.9
GM K1500 SIERRA 4WD 16.9

GM K2500 SIERRA 4WD 16.8
GM K1500 PICKUP 4WD 16.8
FORD F250 PICKUP 2WD 16.6
NISSAN TRUCK CAB CHASS 16.5
FORD F250 PICKUP 4WD 16.5

CHRYSLER D250 PICKUP 2WD 14.9
CHRYSLER W100/W150 PICKU 14.8

CHRYSLER W250 PICKUP 4WD 13.1
CHRYSLER D250 CAB CHASSI 13.0

***** UNADJ
LARGE VANS 55/45
***** MPG

GM G15/25 RALLY 2WD 18.7
GM G10/20 SPORTVAN 18.5
GM G15/25 VANDURA 18.5
GM G10/20 VAN 2WD 18.4

CHRYSLER B150/B250 VAN 2 17.1

FORD E150 ECONOLINE 16.8

FORD E150 CLUB 16.3
CHRYSLER B150/B250 16.3
GM G30 VAN 2WD 16.2
GM G35 VANDURA 2WD 16.2

FORD E250 ECONOLINE 16.0

GM G35 RALLY 2WD 15.9

GM G30 SPORTVAN 2WD 15.9

CHRYSLER B350 VAN 2WD 15.9

CHRYSLER B350 2WD 14.6

***** UNADJ
LARGE UTILITY 55/45
***** MPG

GM R1500 SUBURBAN 22.1

GM V1500 BLAZER 4WD 21.7

GM V1500 JIMMY 4WD 21.7

GM V1500 SUBURBAN 21.0

GM R10 SUBURBAN 2WD 18.2
GM R15 SUBURBAN 2WD 18.2

GM V10 BLAZER 4WD 17.3
GM V15 JIMMY 4WD 17.3

FORD BRONCO 4WD 16.1

GM V10 SUBURBN 4WD 15.9

GM V15 SUBURBAN 4WD 15.9

CHRYSLER AD150 RAMCHARGE 15.6
TOYOTA LAND CRUISER WA 15.4
RANGE ROVER 15.4

CHRYSLER GRAND WAGONEER 13.7
CHRYSLER AW150 RAMCHARGE 13.4

Appendix C - Characteristics of 1989 Passenger Cars by Size Class

	Passenger Cars						-- Station Wagons --		
	Two Seater	Mini Compact	Sub Compact	Compact	Midsize	Large	Small	Midsize	Large
Domestic									
Sales(000)	33		403	1901	2079	1361	60	212	184
Fraction	.213		.199	.518	.887	.988	.244	.815	1.000
55/45 FE	23.1		25.4	30.2	26.7	24.2	32.4	25.7	22.8
Wt(lbs)	3500		3335	2873	3335	3697	2732	3486	4413
Ton-MPG	40.5		42.6	43.6	44.7	44.7	44.4	45.0	50.4
Disp(CI)	319		210	136	186	256	122	188	306
CID/Lb	.091		.062	.047	.055	.069	.045	.054	.069
% FWD	29.0		31.8	99.2	84.2	68.0	100.0	100.0	
% 4WD				.8	.1				
% Man.Tr	3.4		31.3	21.6	6.0		22.4		
% Inject	100.0		100.0	100.0	98.6	93.2	100.0	100.0	17.4
% TBI			25.4	57.4	26.2	17.5	90.8	9.3	
% Port	100.0		74.6	42.6	72.4	75.7	9.2	90.7	17.4
% Carb					1.4	6.8			82.6
% Diesel									
Eng-Hp	222		151	106	130	158	92	136	142
Hp/CID	.696		.737	.781	.711	.630	.756	.728	.463
Hp/Lb	.063		.045	.037	.039	.043	.034	.039	.032
0 to 60	8.4		11.5	12.9	12.4	11.4	13.6	12.2	14.2
Cu.Ft	50		95	103	114	126	120	143	161
Cu.Ft MPG	1157		2437	3137	3077	3059	3924	3682	3681
Cu.Ft Ton MPG	2025		4040	4486	5103	5651	5350	6406	8117
European									
Sales(000)	19	30	127	249	92	16	12	48	
Fraction	.125	1.000	.063	.068	.039	.012	.047	.185	
55/45 FE	18.4	24.5	25.1	26.0	21.3	25.7	31.3	25.8	
Wt(lbs)	3839	2861	3027	3113	3694	3499	2500	3517	
Ton-MPG	35.8	35.3	38.3	40.8	39.6	45.1	39.1	45.4	
Disp(CI)	278	159	149	140	194	121	109	144	
CID/Lb	.070	.054	.048	.045	.052	.035	.044	.041	
% FWD	10.2	42.2	42.8	48.2	23.0	100.0	100.0	6.1	
% 4WD			4.2		5.1			.4	
% Man.Tr	22.5	78.6	54.3	36.2	8.9	35.0	100.0	17.4	
% Inject	100.0	100.0	99.5	98.9	100.0	100.0	100.0	100.0	
% TBI									
% Port	100.0	100.0	99.5	98.9	100.0	100.0	100.0	100.0	
% Carb									
% Diesel			.5	1.1					
Eng-Hp	219	171	142	135	172	151	81	123	
Hp/CID	.856	1.036	.945	.968	.912	1.248	.743	.850	
Hp/Lb	.057	.058	.046	.043	.046	.043	.032	.035	
0 to 60	9.2	9.7	11.1	11.4	10.9	11.2	13.8	13.4	
Cu.Ft	50	73	91	105	114	124	111	134	
Cu.Ft MPG	957	1863	2342	2787	2461	3201	3477	3476	
Cu.Ft Ton MPG	1790	2592	3469	4270	4494	5599	4347	6097	

Appendix C - Characteristics of 1989 Passenger Cars by Size Class (cont'd)

		----- Passenger Cars -----					-- Station Wagons --			
		Two Seater	Mini Compact	Sub Compact	Compact	Midsize	Large	Small	Midsize	Large
		-----	-----	-----	-----	-----	-----	-----	-----	-----
Asian	Sales(000)	103		1491	1518	173		176		
	Fraction	.662		.738	.414	.074		.709		
	55/45 FE	31.3		34.7	30.2	27.1		31.0		
	Wt(lbs)	2697		2522	2930	3066		2980		
	Ton-MPG	44.5		44.1	44.4	41.7		46.3		
	Disp(CI)	123		96	120	143		109		
	CID/Lb	.045		.038	.041	.047		.036		
	% FWD	59.8		92.2	98.6	86.8		70.1		
	% 4WD			2.9	.5			29.9		
	% Man.Tr	83.4		61.0	40.0	33.1		38.5		
	% Inject	100.0		55.6	76.3	100.0		100.0		
	% TBI	20.8		20.6	18.8			42.0		
	% Port	79.2		35.0	57.4	100.0		58.0		
	% Carb			44.4	23.7					
	% Diesel									
	Eng-Hp	120		90	107	121		100		
	Hp/CID	.978		.917	.880	.845		.920		
	Hp/Lb	.043		.035	.036	.039		.034		
	0 to 60	11.3		13.5	13.0	12.1		13.7		
	Cu.Ft	50		94	103	113		119		
	Cu.Ft MPG	1755		3377	3176	3089		3729		
	Cu.Ft Ton MPG	2225		4147	4574	4725		5538		
Fleet	Sales(000)	155	30	2021	3668	2345	1377	247	260	184
	55/45 FE	26.9	24.5	31.6	29.9	26.5	24.2	31.3	25.7	22.8
	Wt(lbs)	3011	2861	2716	2913	3329	3695	2897	3491	4413
	Ton-MPG	42.6	35.3	43.5	43.7	44.3	44.7	45.5	45.0	50.4
	Disp(CI)	184	159	122	130	183	255	112	180	306
	CID/Lb	.058	.054	.043	.044	.055	.069	.039	.051	.069
	% FWD	47.0	42.2	77.1	95.5	82.0	68.4	78.8	82.6	
	% 4WD			2.4	.6	.3		21.2	.1	
	% Man.Tr	58.8	78.6	54.7	30.2	8.1	.4	37.5	3.2	
	% Inject	100.0	100.0	67.2	90.1	98.8	93.2	100.0	100.0	17.4
	% TBI	13.8		20.3	37.5	23.3	17.3	51.9	7.6	
	% Port	86.2	100.0	46.9	52.6	75.5	75.9	48.1	92.4	17.4
	% Carb			32.8	9.8	1.2	6.8			82.6
	% Diesel			.0	.1					
	Eng-Hp	154	171	105	108	131	157	97	133	142
	Hp/CID	.903	1.036	.883	.835	.729	.637	.872	.750	.463
	Hp/Lb	.049	.058	.037	.037	.039	.043	.034	.038	.032
	0 to 60	10.4	9.7	13.0	12.9	12.3	11.4	13.7	12.5	14.2
	Cu.Ft	50	73	94	103	114	126	119	141	161
	Cu.Ft MPG	1528	1863	3124	3130	3054	3060	3764	3644	3681
	Cu.Ft Ton MPG	2128	2592	4083	4508	5051	5650	5436	6349	8117

Appendix D - Characteristics of 1989 Light Duty Trucks by Size Class

		Small Pickups	Large Pickups	Small Van	Large Van	Small Utility	Large Utility
Domestic Sales(000)	Fraction	.572	.903	.878	1.000	.649	.937
	55/45 FE	24.2	18.9	23.1	17.3	21.4	16.3
	Wt(Lbs)	3324	4315	3817	4664	3722	5072
	Ton-MPG	40.6	41.0	44.1	40.6	40.0	41.9
	Disp(CI)	179	298	193	310	227	339
	CID/Lb	.053	.069	.050	.067	.061	.067
	% FWD		.0	56.1			
	% 4WD	22.0	32.7			85.1	72.0
	% Man.Tr	62.3	19.1	7.6	1.9	25.6	1.0
	% Inject	100.0	99.4	100.0	99.7	94.2	91.2
	% TBI	38.4	69.0	40.7	54.4	39.9	61.8
	% Port	61.6	30.4	59.3	45.3	54.3	29.4
	% Carb		.0			5.8	6.8
	% Diesel		.6		.3		2.0
	Eng-Hp	125	167	138	165	154	184
	Hp/CID	.705	.560	.729	.531	.689	.543
	Hp/Lb	.037	.039	.036	.035	.042	.036
Import	Sales(000)	416	126	103		285	12
	Fraction	.428	.097	.122		.351	.063
	55/45 FE	26.6	22.6	25.0		22.1	15.4
	Wt(Lbs)	2960	3662	3476		3698	4500
	Ton-MPG	39.4	41.9	43.6		41.1	34.6
	Disp(CI)	142	157	134		153	241
	CID/Lb	.048	.043	.039		.041	.053
	% FWD			14.3			
	% 4WD		88.2	23.5		81.9	100.0
	% Man.Tr	82.8	83.9	35.0		63.4	
	% Inject	29.0	79.5	100.0		89.8	100.0
	% TBI	22.8	27.8	1.9		22.8	
	% Port	6.2	51.7	98.1		66.9	100.0
	% Carb	71.0	20.5			10.2	
	% Diesel						
	Eng-Hp	100	121	100		121	162
	Hp/CID	.705	.767	.746		.790	.674
	Hp/Lb	.034	.033	.029		.033	.036
Fleet	Sales(000)	971	1302	845	430	813	184
	55/45 FE	25.1	19.2	23.3	17.3	21.7	16.2
	Wt(Lbs)	3168	4252	3776	4664	3713	5036
	Ton-MPG	40.1	41.1	44.0	40.6	40.4	41.5
	Disp(CI)	163	285	186	310	201	333
	CID/Lb	.051	.066	.049	.067	.054	.066
	% FWD		.0	51.0			
	% 4WD	12.6	38.1	2.9		84.0	73.8
	% Man.Tr	71.1	25.4	11.0	1.9	38.8	.9
	% Inject	69.6	97.4	100.0	99.7	92.7	91.8
	% TBI	31.7	65.0	36.0	54.4	33.9	57.9
	% Port	37.9	32.4	64.0	45.3	58.8	33.9
	% Carb	30.4	2.0			7.3	6.4
	% Diesel		.6		.3		1.9
	Eng-Hp	114	162	133	165	142	183
	Hp/CID	.705	.580	.731	.531	.725	.551
	Hp/Lb	.036	.038	.035	.035	.038	.036

Appendix E - Characteristics of 1989 Passenger Cars by Weight Class

	Under 2250 ----	2250 ----	2500 ----	2750 ----	3000 ----	3500 ----	4000 ----	Over 4000 ----
Domestic								
Sales(000)			212	766	2127	2091	807	231
Fraction			.134	.647	.690	.743	.878	.964
55/45 FE			35.4	31.8	28.3	25.2	23.5	22.8
Wt(Lbs)			2500	2750	3000	3500	4000	4500
Ton-MPG			44.6	43.9	42.7	44.3	47.3	51.2
Disp(CI)			116	125	155	216	272	307
CID/Lb			.046	.045	.052	.062	.068	.068
% FWD			100.0	100.0	96.5	88.6	11.3	
% 4WD					.7	.1		
% Man.Tr			57.4	21.9	9.6	7.0	4.6	
% Inject			100.0	100.0	100.0	100.0	94.7	
% TBI			100.0	87.9	38.4	12.5	11.1	
% Port				12.1	61.6	87.5	83.6	
% Carb							5.3	100.0
% Diesel								
Eng-Hp			89	95	116	154	150	140
Hp/CID			.772	.765	.752	.726	.560	.456
Hp/Lb			.036	.035	.039	.044	.037	.031
0 to 60			12.9	13.4	12.5	11.2	12.8	14.6
Cu.Ft			103	104	108	117	126	150
Cu.Ft MPG			3668	3304	3070	2967	2986	3413
Cu.Ft Ton MPG			4585	4543	4605	5192	5973	7680
European								
Sales(000)			71	82	164	181	86	9
Fraction			.045	.070	.053	.064	.094	.036
55/45 FE			30.9	31.1	24.8	24.0	19.4	15.5
Wt(Lbs)			2500	2750	3000	3500	4000	4611
Ton-MPG			38.8	43.3	37.4	42.2	39.2	36.0
Disp(CI)			109	109	141	153	251	331
CID/Lb			.044	.040	.047	.044	.063	.072
% FWD			99.7	97.6	34.3	18.5		
% 4WD					2.0	3.9		
% Man.Tr			93.2	64.7	43.2	16.0	2.4	.2
% Inject			100.0	96.8	100.0	99.7	100.0	100.0
% TBI								
% Port			100.0	96.8	100.0	99.7	100.0	100.0
% Carb								
% Diesel				3.2		.3		
Eng-Hp			84	106	143	151	211	268
Hp/CID			.773	.966	1.017	.989	.869	.825
Hp/Lb			.034	.038	.048	.043	.053	.058
0 to 60			13.5	12.3	10.7	11.5	9.6	8.9
Cu.Ft			92	103	98	112	102	87
Cu.Ft MPG			2847	3232	2463	2720	2030	1364
Cu.Ft Ton MPG			3559	4444	3694	4760	4061	3143

Appendix E - Characteristics of 1989 Passenger Cars by Weight Class (cont'd)

		Under 2250 ----	2250 ----	2500 ----	2750 ----	3000 ----	3500 ----	4000 ----	Over 4000 ----
Asian	Sales(000)	207	261	1296	335	792	542	26	
	Fraction	1.000	1.000	.821	.283	.257	.193	.028	
	55/45 FE	46.4	40.1	35.1	31.7	28.3	25.8	23.0	
	Wt(lbs)	1974	2250	2500	2750	3000	3500	4000	
	Ton-MPG	46.7	45.5	44.1	43.8	42.7	45.5	46.0	
	Disp(CI)	74	89	94	107	127	147	180	
	CID/Lb	.038	.040	.038	.039	.042	.042	.045	
	% FWD	100.0	96.4	99.9	95.5	86.0	83.1		
	% 4WD		3.6	.1	4.2	7.6	3.2		
	% Man.Tr	77.8	66.4	59.6	54.7	41.4	17.8	51.5	
	% Inject	51.9	33.0	56.7	64.6	91.3	100.0	100.0	
	% TBI	28.1	27.6	33.2	25.9	3.8	2.0		
	% Port	23.8	5.4	23.6	38.8	87.5	98.0	100.0	
	% Carb	48.1	67.0	43.3	35.4	8.7			
	% Diesel								
	Eng-Hp	59	77	81	101	116	143	215	
	Hp/CID	.806	.865	.860	.954	.915	.972	1.196	
	Hp/Lb	.030	.034	.032	.037	.039	.041	.054	
	0 to 60	14.8	13.4	14.1	12.8	12.3	12.0	9.4	
	Cu.Ft	92	94	98	98	102	103	85	
	Cu.Ft MPG	4302	3777	3465	3125	2902	2690	1961	
	Cu.Ft Ton MPG	4230	4249	4331	4296	4354	4708	3923	
Fleet	Sales(000)	207	261	1579	1183	3083	2814	920	240
	55/45 FE	46.4	40.1	35.0	31.8	28.1	25.2	23.1	22.4
	Wt(lbs)	1974	2250	2500	2750	3000	3500	4000	4504
	Ton-MPG	46.7	45.5	43.9	43.8	42.4	44.4	46.5	50.7
	Disp(CI)	74	89	98	119	147	199	267	308
	CID/Lb	.038	.040	.039	.043	.049	.057	.067	.068
	% FWD	100.0	96.4	99.9	98.6	90.5	83.0	9.9	
	% 4WD		3.6	.1	1.2	2.6	.9		
	% Man.Tr	77.8	66.4	60.8	34.2	19.5	9.6	5.7	.0
	% Inject	51.9	33.0	64.5	89.8	97.8	100.0	95.4	3.6
	% TBI	28.1	27.6	40.6	64.2	27.4	9.7	9.8	
	% Port	23.8	5.4	23.8	25.6	70.3	90.3	85.6	3.6
	% Carb	48.1	67.0	35.5	10.0	2.2		4.6	96.4
	% Diesel				.2		.0		
	Eng-Hp	59	77	82	97	118	152	158	145
	Hp/CID	.806	.865	.844	.832	.808	.791	.607	.469
	Hp/Lb	.030	.034	.033	.035	.039	.043	.039	.032
	0 to 60	14.8	13.4	13.9	13.1	12.4	11.4	12.4	14.4
	Cu.Ft	92	94	99	102	106	114	123	148
	Cu.Ft MPG	4302	3777	3465	3248	2995	2898	2867	3340
	Cu.Ft Ton MPG	4230	4249	4331	4466	4492	5071	5735	7517

Appendix E - Characteristics of 1989 Light Trucks by Weight Class

		Under 2750	2750	3000	3500	4000	4500	5000	Over 5000
		----	----	----	----	----	----	----	----
Domestic	Sales			291	915	1042	899	427	30
	Fraction			.472	.836	.789	.987	1.000	1.000
	55/45 FE			27.2	22.5	21.7	17.9	16.4	16.6
	Ton-MPG			41.2	39.7	43.6	40.6	41.4	49.1
	Disp(CI)			152	196	234	319	328	355
	CID/Lb			.051	.056	.059	.071	.066	.061
	% FWD				27.3	16.0			
	% 4WD			3.9	37.7	30.3	24.2	38.8	81.9
	% Man.Tr			81.8	33.1	12.8	9.3	3.3	.4
	% Inject			100.0	96.7	100.0	98.4	99.0	82.2
	% TBI			54.6	35.2	59.4	63.9	41.9	79.1
	% Port			45.4	61.4	40.6	34.5	57.1	3.2
	% Carb				3.3		1.3		
	% Diesel						.3	1.0	17.8
	Eng-Hp			105	138	150	173	179	197
	Hp/CID			.691	.714	.659	.542	.543	.557
	Hp/Lb			.035	.039	.037	.039	.036	.034
Imports	Sales	48	99	325	180	278	12		
	Fraction	1.000	1.000	.528	.164	.211	.013		
	55/45 FE	32.2	27.7	26.3	24.1	20.8	15.4		
	Ton-MPG	38.8	38.2	39.5	42.7	42.1	34.6		
	Disp(CI)	91	135	141	147	166	240		
	CID/Lb	.038	.049	.047	.042	.041	.053		
	% FWD			3.9	1.1				
	% 4WD	100.0		1.3	53.3	79.5	100.0		
	% Man.Tr	72.6	100.0	75.5	68.3	59.1			
	% Inject	62.6		39.8	79.4	100.0	100.0		
	% TBI	62.6		25.9	11.1	22.5			
	% Port			13.8	68.2	77.5	100.0		
	% Carb	37.4	100.0	60.2	20.6				
	% Diesel								
	Eng-Hp	74	97	99	110	130	162		
	Hp/CID	.813	.721	.702	.750	.786	.674		
	Hp/Lb	.031	.035	.033	.031	.033	.036		
Fleet	Sales	48	99	616	1095	1320	911	427	30
	55/45 FE	32.2	27.7	26.7	22.7	21.5	17.8	16.4	16.6
	Ton-MPG	38.8	38.2	40.3	40.2	43.3	40.5	41.4	49.1
	Disp(CI)	91	135	146	188	220	318	328	355
	CID/Lb	.038	.049	.049	.054	.055	.071	.066	.061
	% FWD			2.1	23.0	12.6			
	% 4WD	100.0		2.5	40.3	40.6	25.2	38.8	81.9
	% Man.Tr	72.6	100.0	78.5	38.8	22.6	9.2	3.3	.4
	% Inject	62.6		68.2	93.8	100.0	98.4	99.0	82.2
	% TBI	62.6		39.5	31.3	51.7	63.1	41.9	79.1
	% Port			28.8	62.6	48.3	35.3	57.1	3.2
	% Carb	37.4	100.0	31.8	6.2		1.3		
	% Diesel						.2	1.0	17.8
	Eng-Hp	74	97	102	133	146	173	179	197
	Hp/CID	.813	.721	.697	.720	.686	.544	.543	.557
	Hp/Lb	.031	.035	.034	.038	.036	.039	.036	.034