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The Effect of Gasoline Prices on the Demand for Sport Utility Vehicles

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Abstract

This paper uses household data from the 1988 to 2000 U.S. Consumer Expenditure Surveys to examine the determinants of new vehicle purchases, where vehicles are disaggregated into four categories: cars, trucks, vans, and sport-utility vehicles (SUVs). In particular, it analyzes the effect on vehicle choice of gas prices at time of vehicle purchase relative to that of gas prices in previous quarters, controlling for household demographic and location characteristics. Preliminary results suggest that households weigh previous quarters' gas prices more heavily than contemporaneous ones when making vehicle purchasing decisions. This suggests that estimating medium and long run behavioral responses is important for accurately modeling the relationship between gasoline prices, vehicle purchases, and emissions.

I. Introduction

In 1999, transportation became the largest end use producer of carbon dioxide from fossil fuels in the United States. Gasoline powered vehicles are responsible for about 60 percent of the carbon from the transportation sector. They also emit the majority of carbon monoxide and substantial proportions of oxides of nitrogen and volatile organic compounds over all sectors (ORNL, 2004). The share of sport utility vehicles (SUVs) in new vehicle purchases rose from about 6 percent in 1988, about the same share as vans, to 20 percent by 2000 (*Ward's Automotive Yearbooks*, 1988-2000). SUVs are therefore one of the fastest growing, if not the fastest growing, sources of both global warming and criteria pollutants in the United States.

The popular press has suggested that the SUV boom took place for two main reasons.¹ First, U.S. vehicle manufacturers, facing stiff competition from Japanese car manufacturers and Corporate Average Fuel Economy (CAFE) standards that were more stringent for cars, engaged in aggressive campaigns to popularize SUVs. Manufacturers made SUVs more car-like to appeal to the increasingly affluent and style-conscious baby boomers to whom they were selling. Second, real gas prices fell over the 1990s, reducing per mile operating costs for even inefficient large SUVs.

This paper focuses on the latter explanation. It uses household data to examine the determinants of new vehicle purchases from 1988 to 2000. In particular, I analyze the effect on the choice to buy a car, truck, van, or SUV of gas prices at time of vehicle purchase relative to that of gas prices in the year previous to vehicle purchase, controlling for household demographic and location characteristics. This paper takes a preliminary step in a larger research project whose goal it is to understand how households' expectations of gas prices are structured, and how these expectations affect vehicle purchasing decisions. The broader project asks how high gas prices would need to be, and how long gas prices would need to be high, in order to bring about significant

¹ See for example Bradsher (2002).

changes in vehicle purchasing decisions. Such findings are important for forecasting vehicle market outcomes in the context of volatile gas prices and for modeling emissions from the transport sector.

Only a few academic papers study the determinants of the light-duty truck boom.² Plaut (2004) uses the 2001 American Housing Survey to examine the demographic characteristics of drivers that commute via light-duty trucks.³ She finds that light truck commuters have higher salaries and education than those who commute using cars, but does not disaggregate light-trucks into truck, van, and SUV categories or include gasoline prices. Kockelman and Zhao (2000) use the 1995 Nationwide Personal Transportation Survey (NPTS), which enables them to disaggregate light trucks into finer categories. They find that pickups tend to be driven by males, be owned by smaller households, and carry fewer people, and that SUV and minivan occupancies and total annual mileages are higher than those of passenger cars. They do not include gas prices in their estimation. Neither of these studies examines changes in light truck purchases over time.

Godek (1997) includes gas prices as a control variable when analyzing time series of aggregate sales shares of light trucks and cars. He focuses on the effect of CAFE standards on light truck share of passenger vehicle sales. He finds that the introduction of CAFE more than tripled the slope on the time trend of light truck sales and that about half of the increase in light truck share between 1975 and 1995 is attributable to CAFE. Godek's results also show that last year's gas price has a statistically significant negative effect on light truck share of sales. This paper does not control for the effect of changing demographic characteristics on light truck share, does not disaggregate

² A few papers focus on vehicles and safety. Gayer (2004) examines the public health consequences of the regulatory subsidy given to light trucks by CAFE. He finds that light trucks are more dangerous to others in a crash but less dangerous for those driving them. He also finds, however, that light trucks are more likely to crash than cars, which neutralizes the safety advantage to those who drive them. For another article on light trucks and safety, see White (2004).

³ Pickup trucks, SUVs, and vans under 8,500 lbs. gross vehicle weight are all classified as light-duty trucks. Some new SUVs heavier than 8,500 lbs. are heavy duty trucks.

light trucks, and does not explore alternative specifications of the effect of gas prices on purchase decisions.

I use data from the 1988 to 2000 Consumer Expenditure Surveys matched with gasoline price data from the U.S. Energy Information Administration to estimate a simple multinomial logit of the choice to buy a car, truck, van, or SUV. Preliminary estimates suggest that households weigh previous quarters' gas prices more heavily than contemporaneous ones when making vehicle purchasing decisions. Higher gas prices reduce the likelihood of buying vehicles other than cars, relative to cars, with the largest reduction in purchase probability occurring for vans, followed by SUVs, then trucks. While trucks and vans appear to be favored by specific demographic groups in particular regions, SUVs appear to appeal across the population.

Section II outlines a simple model of vehicle choice. Section III describes the data used and presents summary statistics, Section IV discusses estimation and results, and Section V makes preliminary conclusions and establishes directions for further research.

II. Vehicle Choice Model

This model focuses on the discrete choice of vehicle type, conditional on a household having chosen to purchase one new vehicle, j , where j can be a car, sport-utility vehicle, van, or truck. Given the purchase of vehicle type j , the consumer has a conditional expected indirect utility function

$$V_j = f(j, y - r_j, a_j, h, (E(c_j) | p_t, p_{t-s}), \varepsilon_j, \eta) \quad (1)$$

where y is household quarterly total expenditures, r_j is the purchase period's (i.e. yearly, quarterly, or monthly) life-cycle cost of vehicle j , a_j is observable attributes of vehicle j , and h is observed household characteristics. The term ε_j is unobserved attributes of bundle j , and η is unobserved household characteristics.

$E(c_j)$ is the expected cost per mile for vehicle type j , which is equal to the price of gasoline per gallon, p , divided by miles per gallon (MPG_j). Households may form expectations of this operating cost using information on current gasoline price p_t , gasoline prices in previous periods p_{t-s} , or both.

The quarterly life-cycle cost of vehicle j can be broken into two components:

$$r_j = c_j q_j + \rho r_{kj} \quad (2)$$

where q_j is typical quarterly miles driven by a household in vehicle j , ρ is an exogenous discount factor, and r_{kj} is the capital cost of vehicle j . Typical quarterly miles represents the number of miles that a household expects to drive in a vehicle bundle. The price per mile multiplied by typical miles driven $c_j q_j$, is the vehicle bundle's total quarterly operating cost.

The household chooses vehicle j to maximize conditional indirect utility, that is, it chooses bundle j if and only if

$$V_{j^*} > V_j \quad \text{for all } j \text{ other than } j^*$$

Thus, the probability that the household chooses vehicle j^* is

$$P_{j^*} = \text{Prob}(V_{j^*} > V_j \text{ for all } j \text{ other than } j^*) \quad (3)$$

To evaluate this probability, recall that V_j is composed of both observed and unobserved vehicle and household attributes. Combine the effects of all unobserved variables into one composite unobserved variable, take the mean of V_j over this unobserved variable and label this mean \bar{V}_j . Include a term for deviations from the means, μ_j , write this decomposition as

$$V_j = \bar{V}_j + \mu_j \quad (4)$$

If one assumes that μ_j in (3) are jointly distributed according to a generalized extreme value function, then an appropriate estimation technique is multinomial logit.

III. Data and Summary Statistics

A. Vehicle Purchases and Household Characteristics

Vehicle purchase and household characteristics data come from the 1988 through 2000 Consumer Expenditure Surveys (CEX). The CEX includes quarterly expenditures, household demographic characteristics, and detailed information on each household's vehicles. Households provide information about their expenditures over the three months previous to the interview month. Variables in the vehicle file that are relevant for this paper include vehicle vintage, make, model, purchase price and financing information, year and month of purchase, and whether the vehicle was purchased new or used. The CEX includes a variable that categorizes vehicles as either cars or trucks. To further disaggregate the CEX "trucks" into pickups, vans, and SUVs, we found the CEX truck make/models in the *Standard Catalog of American Light-Duty Trucks*, in the *Standard Catalog of 4x4s 1945-2000* or in a number of other sources.

Of the 521,938 vehicles in the 1988 through 2000 CEX, only 6,256 are new vehicles purchased in the households' interview quarters.⁴ Of the newly-purchased vehicles, 362 have missing or inaccurate information about make and model, making it impossible to know for certain whether each is a car, SUV, pickup truck, or van.⁵

Because CEX observations are weighted so that the sample represents aggregate spending patterns in the United States, one expects that the CEX trends in vehicle purchases should follow those found using aggregate vehicle sales. Figure 1 shows CEX new vehicle sales shares for the sample period, weighted using CEX sample weights, while Figure 2 graphs new vehicle sales shares

⁴ The 2000 CEX includes some households that were interviewed in the first quarter of 2001 that report purchases made in 2001. I include only those vehicles purchased before 2001.

⁵ One potential solution to this problem is to estimate the likelihood that properly identified vehicles are cars, SUVs, pickup trucks, or vans as a function of other reported vehicle characteristics, then use coefficients from this estimation to assign an car, SUV, van, or truck category to the vehicles whose model is not identified. Other vehicle characteristics are also spottily reported, however, so it may not be feasible to do such an imputation. For the time being, I have left the incompletely identified vehicles out of the estimation sample.

using data on aggregate sales reported in several issues of *Ward's Automotive Yearbook*. Both the CEX data and the aggregate sales data show that the share of cars purchased fell substantially, truck and van purchases stayed about constant, and SUV purchases grew significantly. Using the CEX data, however, overestimates the share of car purchases; the CEX car share is 71 percent in 1988 compared to 68 percent using the *Ward's* data, and 51 percent in 2000 compared to 59 percent using *Ward's* data.

Some of the gap appears to be due to underestimation of truck purchases by the CEX. This may be due to the fact that the CEX does not survey households in Montana, North Dakota, or Wyoming, where light-truck purchase shares are probably higher than the national average. Some of the gap in later years appears to be due to underestimation of SUV purchases by the CEX. Note that the gap between the car sales shares figures rises over time. While the CEX and *Ward's* data basically agree that the share of SUV purchases in 1988 was about 6 or 7 percent, the CEX share of SUVs in 2000 is only 11 percent, while the *Ward's* data puts this figure at 20 percent. This discrepancy may also be due in part to the omission of some SUV-loving states, but also is likely due to the fact that many SUVs in the CEX were inappropriately categorized as cars. The discrepancy grows over time as new SUV models became more car-like.

Since CEX income measures are known to suffer from measurement error, and since annual income does not measure households' use of credit to finance major purchases, I use real total quarterly consumption expenditures to measure purchasing power. I deflate total expenditures to first quarter 1988 terms using the average of the three monthly CPI values for the household's CEX quarter.

B. Gas Price Data

Retail gas prices come from the *Petroleum Marketing Monthly*, published by the U.S. Energy Information Administration. The periodical reports nominal monthly weighted averages of retail prices of unleaded regular gasoline obtained from over 3,500 companies, by state, net of all taxes.⁶ To these prices I add the state and federal gasoline taxes that were in effect those months. Then, I assign each household the average of the three monthly values for their state and CEX quarter and deflate to obtain real quarterly gas price in first quarter 1988 terms.

Figure 3 graphs both nominal and real gas prices, including taxes, by month, along with fitted trend lines, for 1988 through 2000. While nominal gas prices increased over the sample period, until recently, real gas prices fell. The series exhibit a significant amount of variability over the sample period.

C. Summary Statistics

Table 1 provides means and standard deviations of the variables included in the estimation. After dropping households whose state variable is missing or recoded, one that reports negative total expenditures, and another from Washington DC (for which I have no gas price data), 4940 remain.⁷ The table provides averages of the sales share series shown in Figure 1, indicating that cars made up nearly 70 percent of new vehicle purchases, while trucks, SUVs, and vans were respectively about 13 percent, 9 percent, and 8 percent of the total. The average real gas price from 1988 to 2000 is 87 cents, and the standard deviation of 0.10 summarizes the variability evident in Figure 3.

⁶ Thanks again to Mark Skidmore for providing the gas price data. For more information on these data, see http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_marketing_monthly/pmm.html. For an analysis that uses these data to examine the incidence of the gas tax across producers and consumers, see Alm, Sennoga, and Skidmore (2005).

⁷ The CEX suppresses the state of residence for some households in order to meet the Census rule that the smallest geographically identifiable area have a population of at least 100,000. Beginning in the 1994 CEX, a small proportion of household state codes are replaced with codes of states other than the state where the household resides. Because the CEX reports region for all households, in future drafts I plan to assign observations with missing or recoded states a regional gas price constructed by weighting states' gas prices within each region.

I expect that an increase in gas prices reduces the likelihood that households purchase less fuel-efficient SUVs, trucks, and vans relative to the likelihood of purchasing a car. Indeed, Table 1 shows that the average gas price for car buyers is higher than that faced by households buying other kinds of vehicles, though the standard deviation of gas prices across vehicle purchase types easily swamps this difference.

The average total quarterly expenditures (in 1988 \$) for the 4940 households that purchased new vehicles is a remarkably high \$21,198, nearly double the mean for the CEX sample that includes those households that did not buy new vehicles, and nearly four times the mean for the sample of households that neither own nor purchase a vehicle. SUV buyers have the highest total expenditures on average, followed by van buyers, car buyers, then truck buyers.

Because the composition of the vehicle fleet currently owned by the household is likely to affect current purchasing decisions, I include dummy variables indicating the presence in the household of each vehicle type, not including the new purchase. Table 1 shows a clear pattern of vehicle type repeat purchasing. Because households with more children may prefer to buy a larger vehicle, I include the number of people in the household less than 18 years of age. Not surprisingly, van buyers have twice as many children on average than households buying other vehicle types. I measure the number of potential drivers as the number in the household at least 16 years of age and include this variable along with the number of income earners to proxy for the importance of vehicle transport to the household. Values of these measures are quite similar across vehicle purchase type. Because certain jobs may require use of a larger or more powerful vehicle and because job choice may proxy for other unobserved preferences, I include indicators for occupation. A truck purchase is notably more likely for a household whose head works in a production capacity or is in the armed forces. City population and region may reflect the degree of congestion,

transportation culture, or access to public transportation and thereby affect vehicle choice. City dwellers in the Northeast buy fewer trucks than others.⁸

I also include age, race, education, marital status of the household head, and an indicator equal to one if his or her spouse has a college degree. Not controlling for other covariates, those with more education are strikingly less likely to buy a truck.

Clearly vehicle purchase prices and financing information (the vehicle capital costs in equation (2)), should be included in the estimation; future drafts if this paper will do so. Their omission, however, is unlikely to bias results in this draft— even if gasoline prices and vehicle prices are correlated, this correlation should be of the same direction and magnitude for all vehicles available for a household’s purchase. This draft’s empirical estimation also omits vehicle attributes such as legroom, horsepower, and cargo space that certainly affect vehicle choice. My hunch is that this omission will not bias coefficients on gasoline price as such attributes are unlikely to be correlated with gasoline prices, but I plan to include them in future versions of this paper. And regrettably for the time being I do not consider the role that typical miles driven plays in vehicle choice, though doing so using CEX data is relatively straightforward.

IV. Estimation and Results

I estimate the probability of choosing a car, truck, van, or SUV using a standard multinomial logit, including only those households that purchased new vehicles.⁹ To explore the effect of gasoline prices on vehicle choice, I estimate three specifications. The first includes the real gas price faced by the household during the quarter in which they bought the vehicle, while the second includes both contemporaneous gas price and gas prices from four previous quarters. Because significant correlation in quarter to quarter gasoline prices makes it difficult to interpret the

⁸ Households with particular demographic characteristics are spread rather thinly across states, precluding use of state fixed effects.

⁹ For more detail on multinomial logit estimation, see Green (2003).

magnitudes of the relative effects of the contemporaneous and four lagged prices, in the third specification I replace the four lagged prices with their average. I use logged gas prices and total expenditures in both specifications, as this results in a better fit.

Coefficients in results tables are interpreted as the marginal effect of the independent variable on the likelihood of choosing an SUV, truck, or van relative to choosing a car.

Table 2 presents results from the specification that includes only contemporaneous gas price. It shows that a doubling of gas price in the quarter of vehicle purchase makes a household 15 percent more likely to buy a car and 8 percent less likely to buy a truck. The remaining 7 percent reduction in likelihood of purchase is split between reductions in van and SUV purchases (van purchases fall by 4.3 percent and SUV purchases by 3.2 percent), though these estimated probabilities are not statistically significant.

Results from including lagged gas prices are reported in Table 3. Taken individually, the two-quarter lagged gas price in the SUV choice is nearly statistically significant but it is positive, indicating that an increase in lagged gas price increases the likelihood of buying an SUV. Gas prices lagged two and three quarters have a statistically significant effect on car purchase but offset each other. A chi-squared test for statistical significance across the three vehicle choices shows that the gas prices are jointly statistically significant at the 2 percent level.

I also estimate and test the significance of the linear combination of the five real gas prices in each equation. Results here are more satisfying. As expected, they are negative for the non-car vehicles, indicating that overall, higher gas prices reduce the probability of buying an SUV, truck, or van versus a car. The largest reduction in purchase probability occurs for vans, followed by SUVs, then trucks. All of the linear combinations are statistically significant at the 2 percent level or better.

Problems obtaining statistically significant estimates of the gas prices taken individually is certainly due in part to the correlation in prices across quarters. Table 4 shows results of estimation that replaces the four lagged prices with their average. Once the average of the past year's gas prices is controlled for, contemporaneous real gas prices do not appear to influence vehicle type choice. Increases in the previous year's gas prices, on the other hand, reduce the likelihood an SUV (10 percent), van (8 percent), or truck (2 percent) is purchased, though the effect on trucks is not statistically significant. Correspondingly, the likelihood of car purchase rises 20 percent when last year's average gas price is doubled.

Tables 2 through 4 provide evidence that truck buyers and van buyers are from specific demographic groups. Not surprisingly, new trucks are preferred by men, those who already own trucks or live in regions other than the Northeast, and to a lesser extent by Asians, blacks, those with some college education, and those that live in larger cities. Vans are more likely to be purchased by married people with larger families, those with more education, those that live in the Midwest, and are less likely to be purchased by blacks or those living in large cities. Those who are professionals, managers, or work in technical, sales or administrative positions are decidedly less likely to purchase trucks.

In contrast, SUVs appear to appeal to all demographic groups, or at least to no particular group. SUV purchasers are not distinguished by race, education, region, or city size. Households are more likely to buy an SUV if they already own a truck or SUV. In some ways, SUV buyers appear to be more like van buyers than they are like truck buyers. While purchasing power, homeownership, and number of drivers do not affect the likelihood of buying a truck versus a car, both SUVs and vans are preferred by homeowners, households with higher total expenditures, and households with more drivers.

V. Preliminary Conclusions and Directions for Further Research

This paper uses household data to examine the effect of gasoline prices, demographic characteristics, and location on vehicle purchase choices. Preliminary results suggest that households weigh previous gasoline prices more heavily than contemporaneous ones when making vehicle purchase decisions. Increases in last year's gas prices reduce the likelihood an SUV is purchased by 10 percent, vans by 8 percent, and trucks by 2 percent. In response to higher gas prices, households shift into car purchases, with the likelihood of car purchase rising 20 percent to offset the reduced likelihood of light-duty truck purchases. This paper also confirms suggestions made by the popular press that SUVs appeal to broader demographics than pickup trucks and vans.

Much remains to be done in this area of research. For the most part, the existing literature models only the effect of contemporaneous gas prices on vehicle choice. Because vehicles are durable goods about whose purchase households may devote significant contemplation, a more realistic framework should model gasoline prices in least three ways: (1) include contemporaneous gas prices, with the possibility that a change in household vehicle choice is triggered when prices reach a specific threshold; (2) include the duration that gas prices remain at a certain level, particularly if above a "trigger" threshold; and (3) include other measures of gas price expectations, particularly as these expectations are influenced by global events such as the outbreak of war in the Middle East or actions taken by OPEC.

Second, what households likely consider when making vehicle purchase decisions are not simply expected gasoline prices, but relative operating costs, which depend on fuel efficiency. How many miles a household plans to drive in a vehicle will determine to at least some extent how much such operating costs figure in the vehicle purchase decision. The kind of vehicle a household drives in turn may affect the number of miles it drives. In order to accurately estimate vehicle choice probabilities, one must estimate the joint choice of vehicle and miles traveled. Many studies

estimate these choices in two stages (see Mannering and Winston (1985), Train (1986), Hensher (1992), Goldberg (1998), and West (2004)). Some recent work estimates these choices simultaneously (see Feng, Fullerton, and Gan (2005) and Bento et al. (2005)).

Third, the discrete choice portion of the vehicle-miles choice is far more complicated than that specified here. Households choose whether or not to buy a vehicle, whether to buy a new or used vehicle, import or domestic, engine size, and options in addition to choosing whether to buy a car, truck, van, or SUV. At the very least a nested logit is warranted here (see Goldberg (1998) or West (2004)), and the more flexible mixed logit specification may produce even more accurate estimates (see McFadden and Train (2000)).

Fourth, other variables important to vehicle choice decisions should be included in the estimation. In addition to the characteristics of vehicles themselves, access to public transportation, climatic (quantity of snow for example) and geographic characteristics such as mountains likely affect vehicle choice.

Fifth, I would like to exploit data that includes the post-2001 increase in gasoline prices and the reduction in SUV sales that occurred in 2005. Aggregate data from this paper's sample period shows monotonically increasing SUV sales shares, and those shares are positively correlated with many other series that also increased monotonically (e.g. obesity and sprawl). Including a time period with a dip in sales will help identify the effects of gasoline price variation.

Sixth, the average vintage-2000 SUV, with its better handling and stability, can hardly be placed in the same category as the far more cumbersome 1988 SUV. Further disaggregation of the light-duty truck category is necessary to capture the effect of evolution of SUV characteristics on sales share.

Last, a host of supply side issues complicate estimation. Vehicle manufacturers are essentially oligopolies. Light-duty trucks face less stringent CAFE and emissions standards and are

treated preferentially by international trade rules. These conditions certainly affected the kinds of SUVs made available to the public; analyzing only the demand side of the SUV story cannot fully explain their rising popularity.

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Table 1: Summary Statistics

Variable	Full Sample		CAR buyers		SUV buyers		VAN buyers		TRUCK Buyers	
	Mean or %	St. dev.	Mean or %	St. dev.	Mean or %	St. dev.	Mean or %	St. dev.	Mean or %	St. dev.
real gas price(t) (1998\$)	0.87	0.10	0.88	0.10	0.87	0.11	0.86	0.09	0.87	0.11
real quarterly total expenditures (1998\$)	21198	9723	20471	9655	26455	11502	23118	7897	20307	8481
% that had car	80.8	.	82.4	.	74.9	.	81.2	.	76.2	.
% that had truck	20.4	.	16.6	.	22.6	.	22.0	.	37.9	.
% that had van	10.2	.	8.3	.	11.4	.	24.9	.	10.1	.
% that had SUV	10.4	.	8.0	.	24.4	.	11.4	.	13.2	.
% HH heads male	70.1	.	67.7	.	72.9	.	77.5	.	76.8	.
% HH heads married	73.8	.	70.7	.	79.7	.	91.1	.	75.3	.
Number in HH <18 years old	0.7	1.0	0.6	1.0	0.8	1.0	1.4	1.3	0.7	1.0
% HH head high school grad	27.0	.	26.0	.	24.1	.	26.7	.	34.9	.
% HH head some college	27.1	.	26.8	.	26.2	.	27.2	.	29.6	.
% HH head college grad	37.4	.	38.7	.	44.6	.	41.2	.	23.2	.
% spouses college grad	26.3	.	27.1	.	31.7	.	30.6	.	16.3	.
Age of HH head	46.0	14.8	46.9	15.4	42.7	12.0	45.3	12.4	43.9	13.7
% owning house	77.6	.	75.6	.	83.1	.	89.4	.	76.7	.
Number of potential drivers	2.2	0.9	2.2	1.0	2.2	0.8	2.3	0.8	2.4	1.0
Number of earners	1.8	1.0	1.7	1.1	1.8	0.9	1.8	0.9	1.9	1.0
% HH head Native American	0.3	.	0.2	.	0.5	.	0.5	.	0.5	.
% HH head Asian	4.2	.	4.7	.	5.0	.	3.2	.	1.5	.
% HH head black	7.1	.	8.2	.	5.9	.	4.0	.	3.8	.
% HH head white	88.5	.	86.9	.	88.6	.	92.3	.	94.2	.
% Managerial & professional specialty	36.5	.	37.0	.	45.6	.	37.0	.	26.9	.
% Technical, sales, and admin. support	21.4	.	21.3	.	21.2	.	21.5	.	21.8	.
% Service	5.9	.	5.9	.	4.6	.	4.0	.	7.5	.
% Farming, forestry, and fishing	0.7	.	0.5	.	0.2	.	0.7	.	1.8	.
% Precision production, craft, and repair	6.6	.	5.5	.	6.4	.	7.7	.	11.8	.
% Operators, fabricators, and laborers	9.5	.	9.3	.	7.5	.	8.6	.	12.1	.
% Armed forces	0.5	.	0.5	.	0.5	.	0.5	.	0.8	.
% Self-employed, Other	19.1	.	20.0	.	14.1	.	20.0	.	17.2	.
% City population > 4 million	21.1	.	23.0	.	20.0	.	20.0	.	11.8	.
% 1.2 mil<city population<4 mil	37.0	.	37.0	.	36.9	.	37.0	.	37.0	.
% city population<1.2 million	41.9	.	39.9	.	43.1	.	43.0	.	51.2	.
% in Northeast	19.8	.	22.1	.	17.1	.	17.3	.	11.4	.
% in Midwest	24.6	.	24.4	.	18.0	.	29.9	.	26.7	.
% in South	34.8	.	33.6	.	40.8	.	33.3	.	38.4	.
% in West	20.8	.	20.0	.	24.1	.	19.5	.	23.5	.
Number of Observations	4940		3445		439		405		651	
% of sample	100.00		69.74		8.89		8.20		13.18	

Table 2: Multinomial Logit Estimation Results: Contemporaneous Gas Price Only

	SUV			TRUCK			VAN			CAR		
	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z
ln(real gas price(t))	-0.032	0.029	0.271	-0.081	0.038	0.033	-0.043	0.026	0.100	0.157	0.052	0.003
ln(total expenditures)	0.087	0.009	0.000	-0.011	0.011	0.301	0.023	0.008	0.005	-0.099	0.015	0.000
equals 1 if had car	-0.027	0.011	0.013	-0.027	0.013	0.038	0.001	0.009	0.935	0.053	0.018	0.003
equals 1 if had truck	0.012	0.010	0.212	0.087	0.014	0.000	0.000	0.008	0.967	-0.099	0.017	0.000
equals 1 if had van	0.013	0.013	0.315	0.004	0.016	0.797	0.055	0.014	0.000	-0.072	0.023	0.002
equals 1 if had SUV	0.083	0.016	0.000	0.030	0.016	0.062	0.002	0.011	0.821	-0.116	0.023	0.000
equals 1 if male	0.008	0.008	0.351	0.034	0.010	0.001	0.008	0.008	0.279	-0.050	0.014	0.000
equals 1 if married	0.013	0.010	0.196	-0.013	0.013	0.325	0.048	0.008	0.000	-0.047	0.018	0.007
number in HH < 18 yrs old	-0.004	0.004	0.239	-0.008	0.005	0.127	0.029	0.003	0.000	-0.017	0.007	0.012
equals 1 if HS grad	0.019	0.019	0.315	-0.016	0.015	0.271	0.036	0.019	0.063	-0.038	0.028	0.171
equals 1 if some college	0.005	0.018	0.761	-0.032	0.015	0.029	0.035	0.019	0.074	-0.008	0.028	0.775
equals 1 if college grad	0.013	0.018	0.473	-0.068	0.017	0.000	0.035	0.019	0.059	0.019	0.029	0.508
equals 1 if spouse college grad	-0.005	0.009	0.609	-0.019	0.013	0.153	-0.008	0.008	0.292	0.032	0.017	0.061
age	0.003	0.002	0.161	0.003	0.002	0.133	0.005	0.002	0.004	-0.011	0.003	0.000
age squared	0.000	0.000	0.023	0.000	0.000	0.022	0.000	0.000	0.007	0.000	0.000	0.000
equals 1 if owns house	0.022	0.009	0.016	-0.001	0.013	0.921	0.020	0.009	0.027	-0.041	0.017	0.017
number potential drivers	-0.016	0.007	0.024	0.007	0.009	0.449	-0.021	0.006	0.001	0.030	0.012	0.012
number earners	0.000	0.007	0.962	0.011	0.008	0.201	-0.005	0.005	0.410	-0.006	0.011	0.608
equals 1 if Native American	0.073	0.098	0.457	0.004	0.069	0.959	0.110	0.112	0.328	-0.186	0.138	0.176
equals 1 if Asian	0.021	0.021	0.319	-0.079	0.014	0.000	-0.018	0.014	0.194	0.076	0.028	0.006
equals 1 if black	0.000	0.015	0.982	-0.059	0.013	0.000	-0.021	0.012	0.063	0.081	0.022	0.000
equals 1 if city population>4 million	-0.005	0.010	0.597	-0.049	0.011	0.000	-0.009	0.009	0.281	0.063	0.016	0.000
equals 1 if 1.2 mil<city population<4 mil	-0.007	0.008	0.402	-0.015	0.010	0.133	-0.003	0.007	0.657	0.025	0.014	0.078
equals 1 if Midwest	-0.009	0.011	0.414	0.064	0.019	0.001	0.022	0.011	0.057	-0.077	0.022	0.001
equals 1 if South	0.014	0.012	0.239	0.060	0.018	0.001	0.005	0.010	0.631	-0.079	0.021	0.000
equals 1 if West	0.003	0.012	0.803	0.080	0.022	0.000	0.004	0.012	0.723	-0.087	0.025	0.000

Notes: Marginal effects are reported here. 4940 observations. Log likelihood is -4144.0752; Pseudo R-squared is 0.1062. For dummy variables, dy/dx measures the effect of a discrete change from 0 to 1. The omitted demographic category is single female white HS dropout renter in a Northeastern city of less than 1.2 million. The third column reports significance level of the z-statistics, analogs to t-statistics. Occupation dummies are also included in estimation; they are jointly significant at the five percent level. Individually, only three occupations in the truck equation are statistically significant (see text for discussion).

Table 3: Multinomial Logit Estimation Results: Contemporaneous and 4 Previous Quarter Lags in Gas Price

	SUV			TRUCK			VAN			CAR		
	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z
ln(real gas price(t))	0.030	0.057	0.599	-0.097	0.074	0.190	0.010	0.052	0.845	0.057	0.102	0.574
ln(real gas price (t-1))	-0.093	0.081	0.246	0.001	0.104	0.989	-0.033	0.073	0.655	0.125	0.143	0.381
ln(real gas price (t-2))	0.137	0.082	0.095	0.143	0.105	0.175	0.005	0.075	0.948	-0.285	0.145	0.050
ln(real gas price (t-3))	-0.095	0.083	0.250	-0.145	0.107	0.175	-0.044	0.077	0.569	0.284	0.147	0.054
ln(real gas price (t-4))	-0.059	0.059	0.317	-0.002	0.075	0.981	-0.013	0.054	0.809	0.074	0.104	0.479
ln(total expenditures)	0.087	0.009	0.000	-0.010	0.011	0.358	0.023	0.008	0.004	-0.101	0.015	0.000
equals 1 if had car	-0.025	0.011	0.019	-0.026	0.013	0.044	0.002	0.009	0.835	0.049	0.018	0.006
equals 1 if had truck	0.011	0.009	0.228	0.087	0.014	0.000	-0.001	0.008	0.917	-0.098	0.017	0.000
equals 1 if had van	0.013	0.013	0.300	0.004	0.016	0.803	0.053	0.014	0.000	-0.071	0.023	0.002
equals 1 if had SUV	0.081	0.016	0.000	0.030	0.016	0.067	0.002	0.010	0.861	-0.113	0.023	0.000
equals 1 if male	0.010	0.008	0.232	0.035	0.010	0.001	0.010	0.008	0.181	-0.055	0.014	0.000
equals 1 if married	0.012	0.010	0.234	-0.014	0.014	0.297	0.047	0.008	0.000	-0.045	0.018	0.011
number in HH < 18 yrs old	-0.004	0.004	0.241	-0.008	0.005	0.125	0.029	0.003	0.000	-0.017	0.007	0.012
equals 1 if HS grad	0.017	0.018	0.350	-0.017	0.015	0.242	0.035	0.019	0.069	-0.035	0.028	0.212
equals 1 if some college	0.003	0.017	0.878	-0.033	0.015	0.023	0.033	0.019	0.084	-0.003	0.028	0.925
equals 1 if college grad	0.012	0.018	0.527	-0.068	0.017	0.000	0.034	0.019	0.064	0.022	0.029	0.443
equals 1 if spouse college grad	-0.004	0.009	0.674	-0.019	0.013	0.149	-0.008	0.008	0.312	0.031	0.017	0.069
age	0.003	0.002	0.149	0.003	0.002	0.127	0.005	0.002	0.004	-0.011	0.003	0.000
age squared	0.000	0.000	0.019	0.000	0.000	0.020	0.000	0.000	0.007	0.000	0.000	0.000
equals 1 if owns house	0.022	0.009	0.018	-0.001	0.013	0.929	0.020	0.009	0.026	-0.041	0.017	0.018
number potential drivers	-0.016	0.007	0.025	0.007	0.009	0.415	-0.021	0.006	0.001	0.030	0.012	0.013
number earners	0.000	0.007	0.980	0.011	0.008	0.205	-0.004	0.006	0.442	-0.006	0.011	0.587
equals 1 if Native American	0.077	0.100	0.441	0.005	0.070	0.945	0.111	0.113	0.324	-0.194	0.139	0.163
equals 1 if Asian	0.020	0.021	0.325	-0.079	0.014	0.000	-0.017	0.014	0.211	0.076	0.027	0.005
equals 1 if black	-0.001	0.015	0.925	-0.059	0.013	0.000	-0.022	0.011	0.054	0.082	0.022	0.000
equals 1 if city population>4 million	-0.009	0.010	0.369	-0.050	0.011	0.000	-0.011	0.008	0.189	0.069	0.016	0.000
equals 1 if 1.2 mil<city population<4 mil	-0.008	0.008	0.322	-0.015	0.010	0.127	-0.004	0.007	0.590	0.027	0.014	0.056
equals 1 if Midwest	-0.008	0.011	0.461	0.065	0.019	0.001	0.023	0.012	0.051	-0.079	0.022	0.000
equals 1 if South	0.010	0.011	0.370	0.060	0.018	0.001	0.003	0.010	0.757	-0.073	0.021	0.001
equals 1 if West	0.004	0.012	0.763	0.080	0.022	0.000	0.004	0.012	0.707	-0.088	0.025	0.000

Notes: Marginal effects are reported here. 4940 observations. Log likelihood is -4133.7227; Pseudo R-squared is 0.1085. For dummy variables, dy/dx measures the effect of a discrete change from 0 to 1. Same omitted demographic category as in Table 2. The third column reports significance level of the z-statistics, analogous to t-statistics. Occupation dummies are also included in estimation; they are jointly significant at the five percent level. Individually, only three occupations in the truck equation are statistically significant (see text for discussion).

Table 4: Multinomial Logit Estimation Results: Contemporaneous and Last Year's Average Gas Price

	SUV			TRUCK			VAN			CAR		
	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z
ln(real gas price(t))	0.030	0.040	0.455	-0.068	0.053	0.203	0.007	0.036	0.851	0.031	0.072	0.664
ln(last year's average gas price)	-0.101	0.044	0.021	-0.022	0.058	0.708	-0.081	0.040	0.043	0.204	0.079	0.010
ln(total expenditures)	0.087	0.009	0.000	-0.011	0.011	0.321	0.023	0.008	0.004	-0.099	0.015	0.000
equals 1 if had car	-0.025	0.011	0.018	-0.026	0.013	0.042	0.002	0.009	0.835	0.050	0.018	0.005
equals 1 if had truck	0.011	0.009	0.240	0.087	0.014	0.000	-0.001	0.008	0.913	-0.097	0.017	0.000
equals 1 if had van	0.012	0.013	0.334	0.004	0.016	0.804	0.053	0.013	0.000	-0.070	0.023	0.002
equals 1 if had SUV	0.081	0.016	0.000	0.030	0.016	0.062	0.002	0.010	0.859	-0.113	0.023	0.000
equals 1 if male	0.009	0.008	0.239	0.035	0.010	0.001	0.010	0.008	0.180	-0.054	0.014	0.000
equals 1 if married	0.012	0.010	0.217	-0.013	0.013	0.320	0.047	0.008	0.000	-0.046	0.018	0.009
number in HH < 18 yrs old	-0.005	0.004	0.233	-0.008	0.005	0.128	0.029	0.003	0.000	-0.017	0.007	0.012
equals 1 if HS grad	0.018	0.019	0.326	-0.017	0.015	0.263	0.035	0.019	0.068	-0.037	0.028	0.190
equals 1 if some college	0.004	0.017	0.814	-0.032	0.015	0.027	0.033	0.019	0.083	-0.005	0.028	0.858
equals 1 if college grad	0.013	0.018	0.492	-0.068	0.017	0.000	0.035	0.019	0.063	0.021	0.029	0.469
equals 1 if spouse college grad	-0.004	0.009	0.647	-0.019	0.013	0.154	-0.008	0.008	0.308	0.031	0.017	0.068
age	0.003	0.002	0.143	0.003	0.002	0.131	0.005	0.002	0.004	-0.011	0.003	0.000
age squared	0.000	0.000	0.018	0.000	0.000	0.022	0.000	0.000	0.007	0.000	0.000	0.000
owns house	0.022	0.009	0.015	-0.001	0.013	0.919	0.020	0.009	0.026	-0.041	0.017	0.017
number potential drivers	-0.017	0.007	0.019	0.006	0.009	0.459	-0.021	0.006	0.001	0.032	0.012	0.009
number earners	0.000	0.007	0.968	0.011	0.008	0.198	-0.004	0.006	0.447	-0.007	0.011	0.548
HH head Native American	0.074	0.099	0.454	0.004	0.070	0.959	0.110	0.112	0.326	-0.188	0.138	0.173
HH head Asian	0.022	0.021	0.295	-0.079	0.014	0.000	-0.017	0.014	0.216	0.074	0.028	0.008
HH head black	-0.001	0.015	0.936	-0.059	0.013	0.000	-0.022	0.011	0.057	0.082	0.022	0.000
city population>4 million	-0.008	0.010	0.406	-0.049	0.011	0.000	-0.011	0.008	0.192	0.068	0.016	0.000
1.2 mil<city population<4 mil	-0.007	0.008	0.369	-0.015	0.010	0.133	-0.004	0.007	0.595	0.026	0.014	0.066
Midwest	-0.009	0.011	0.406	0.064	0.019	0.001	0.022	0.012	0.052	-0.077	0.022	0.001
South	0.010	0.011	0.362	0.060	0.018	0.001	0.003	0.010	0.758	-0.074	0.021	0.001
West	0.003	0.012	0.791	0.080	0.022	0.000	0.005	0.012	0.694	-0.087	0.025	0.000

Notes: Marginal effects are reported here. Log likelihood is -4139.1422; Pseudo R-squared is 0.1073. For dummy variables, dy/dx measures the effect of a discrete change from 0 to 1. Same omitted demographic category as in Table 2. The third column reports significance level of the z-statistics, analogs to t-statistics. Occupation dummies are also included in estimation; they are jointly significant at the five percent level. Individually, all occupations in the truck equation are statistically significant (see text for discussion).

Figure 1

**Vehicle Sales Shares (1988-2000)
(Population-Weighted CEX Data)**

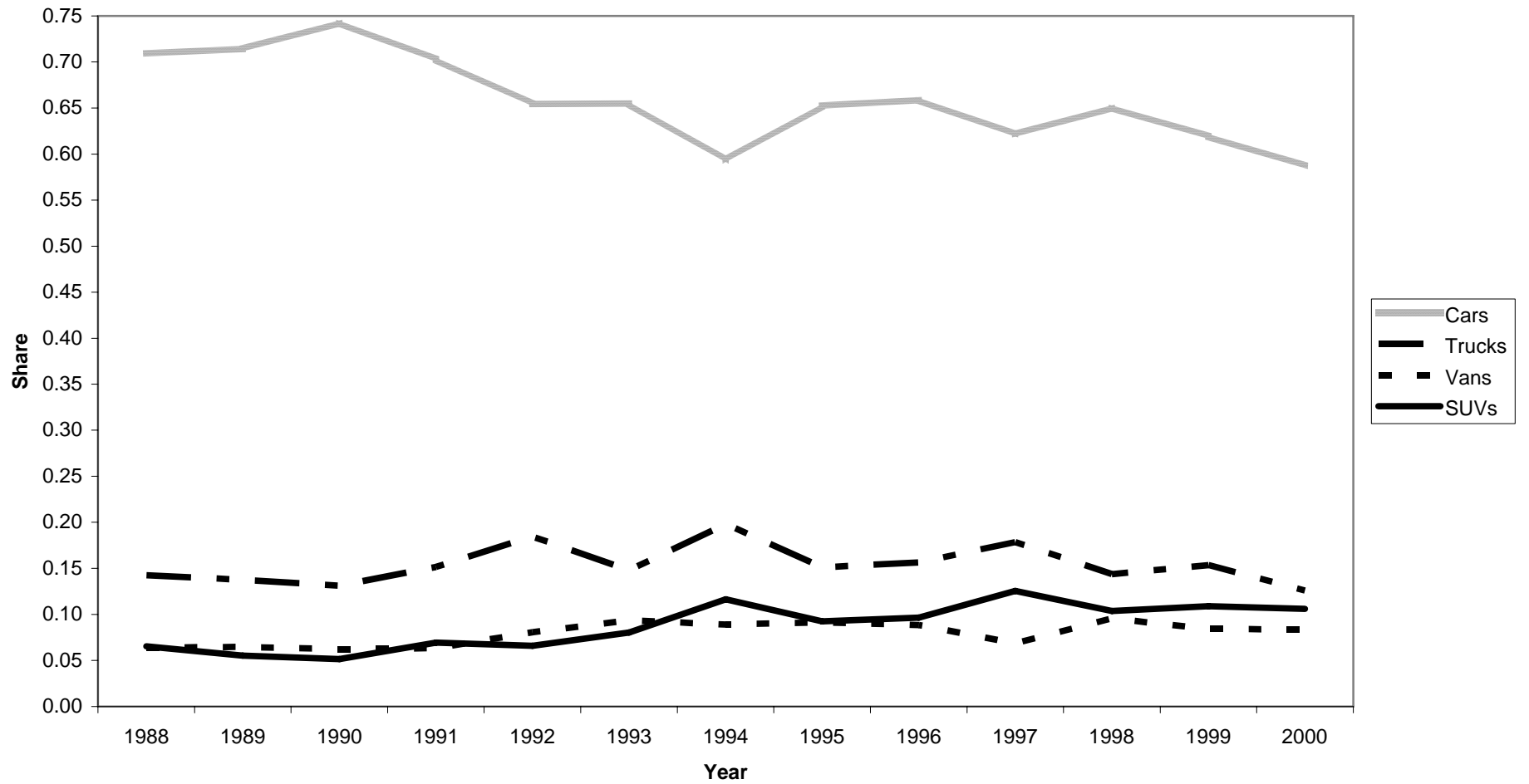


Figure 2

New Vehicle Sales Shares (1988-2000)
(From Total Sales as Reported in *Ward's Automotive Yearbook*)

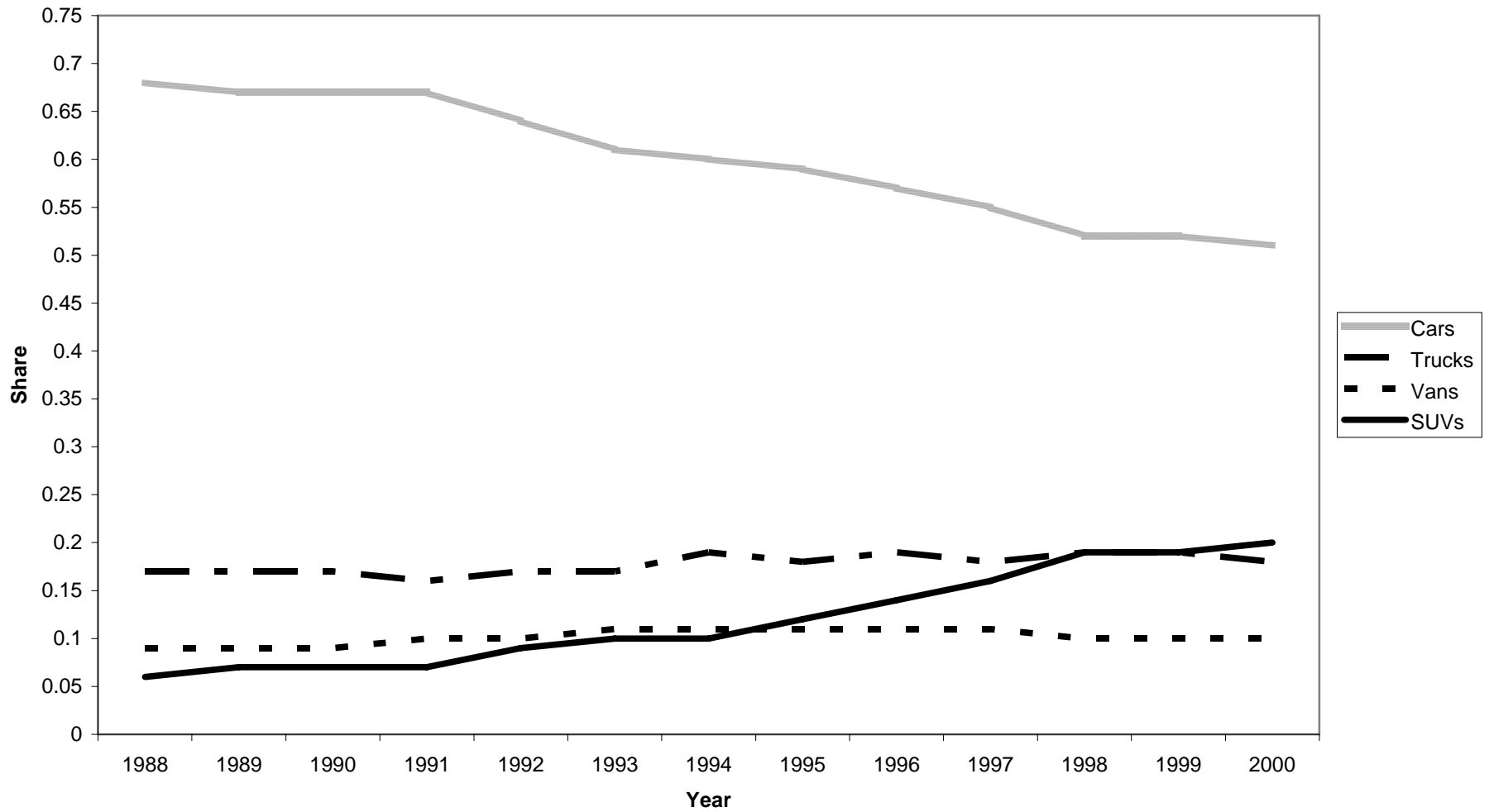


Figure 3

Gas Prices 1988-2000

