



## Short-Term Energy Outlook Supplement: Motor Gasoline Consumption 2008 A Historical Perspective and Short-Term Projections <sup>1</sup>

### *Highlights*

- *Income growth rates have less of an impact on recent trends in gasoline consumption than in the past, but short-run effects are still significant.*
- *High gasoline prices are once again motivating drivers to conserve by driving less and purchasing more fuel-efficient transportation.*
- *The increasing share of lower-Btu-content ethanol has contributed to a growing divergence between volume-based and energy-content-based measures of trends in gasoline consumption.*
- *Consumer sensitivity to gasoline price changes increases during periods when retail prices exceed \$2.50 per gallon.*
- *High gasoline prices and a slowing economy, which have reduced gasoline demand in recent months, are also projected to impact demand during the 2008 summer driving season.*

### ***Overview: Motor Gasoline Consumption Growth Trends***

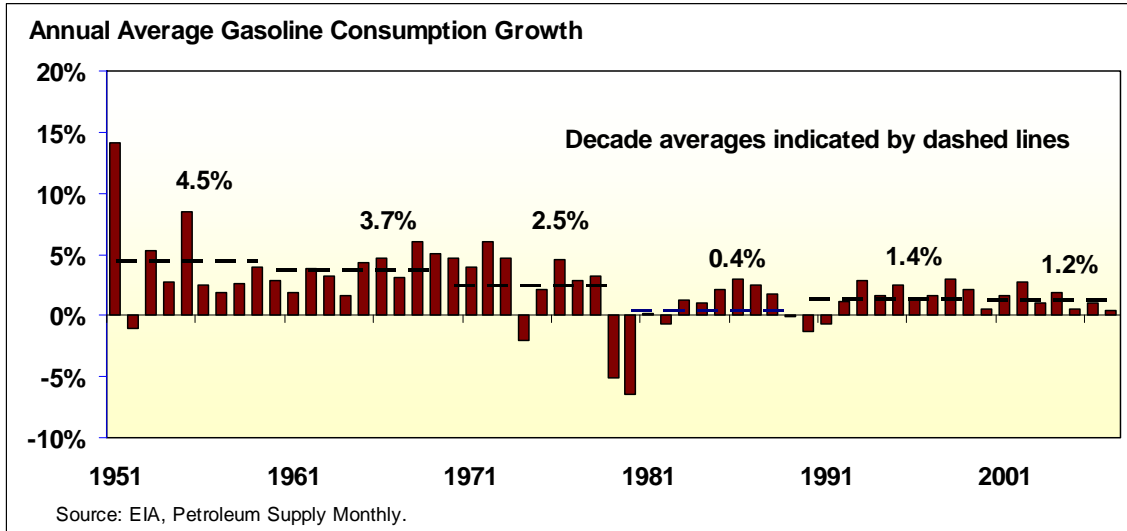
Between 1950 and 1973, motor gasoline consumption growth averaged 4.2 percent per year (Figure 1), similar to the average highway travel growth of 4.7 percent per year (Figure 2), and higher than the 3.9-percent average rate of

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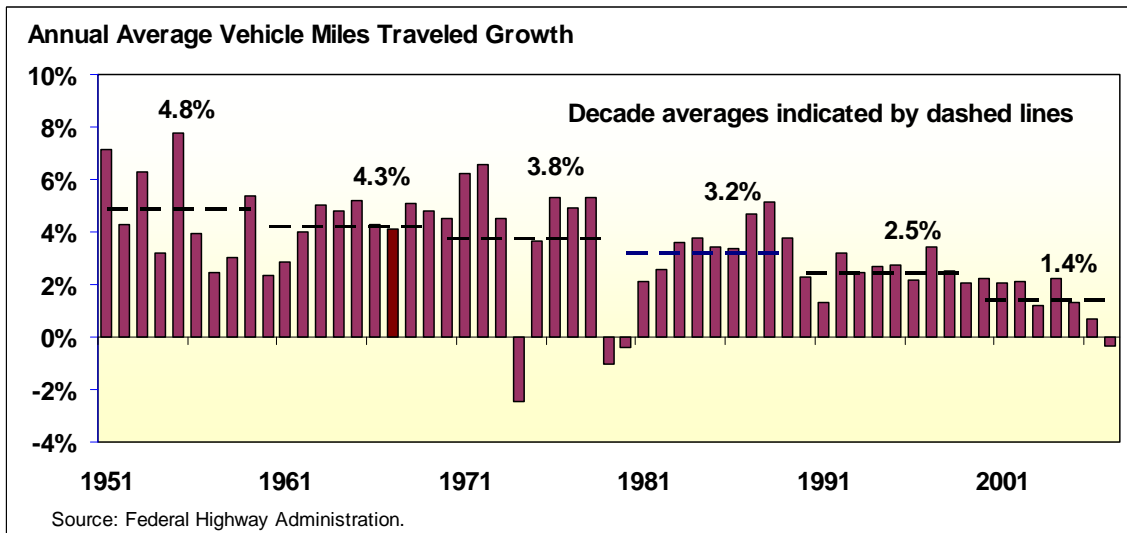
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growth of real disposable income. During this period retail motor gasoline prices and real costs per mile were low and exhibited little variation.

**Figure 1. Annual Average Gasoline Consumption Growth, 1951-2007**



**Figure 2. Annual Average Highway Travel Growth, 1951-2007**



In contrast to the 1950-1973 period, the 1973-1997 period was one of fluctuating crude oil and product prices and a sharp slowdown in motor gasoline consumption growth to an average of 0.8 percent per year. Highway travel growth averaged 2.8 percent per year, similar to that of real disposable personal income (3.1 percent per year). The difference between the gasoline consumption and travel growth rates implies average fuel efficiency improvement of about 2.0

percent per year compared with the average 0.5 percent efficiency growth prior to 1973. The 1973 oil embargo and the recession the following year temporarily halted the upward trend in motor gasoline consumption, but then consumption resumed its upward march as the economy recovered and prices subsided. The Iranian revolution of 1979 ushered in a new period of high and volatile retail prices. The surge in gasoline prices motivated the move to smaller and more fuel-efficient automobiles, which dampened gasoline demand growth. Vehicle miles traveled (VMT) resumed its upward march after the 1980-1982 recession, but gasoline consumption was slowed by the continuing increase in average fleet fuel efficiencies as the new generation of more fuel efficient cars replaced the old. Motor gasoline consumption did not return to its 1978 peak until 1993, even though gasoline-powered VMT had grown by almost 50 percent.

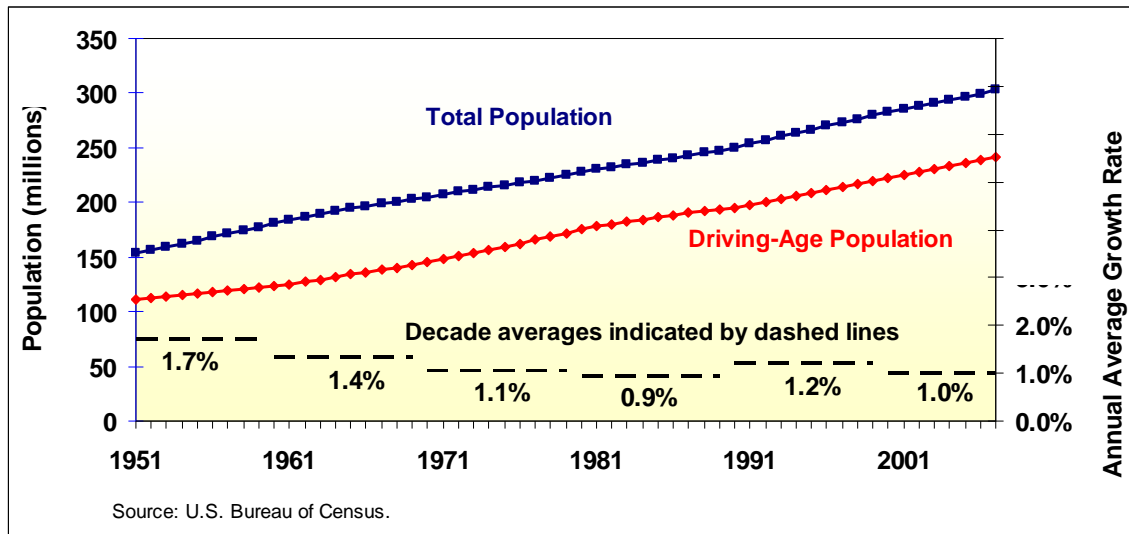
The post-1997 period witnessed a structural shift in motor gasoline markets. Motor gasoline consumption growth averaged 1.5 percent per year, almost twice the growth rate of the turbulent 1973-1997 period; but highway travel growth averaged only 1.6 percent per year, indicating little, if any, increases in average fleet fuel efficiency. Moreover, the highway travel growth was less than half the 3.6-percent growth rate in real disposable personal income. This result occurred despite the fact that real fuel costs per mile were relatively low for much of that period.

Recently, motor gasoline demand growth has been particularly slow. Following growth of 1.0 percent in 2006, consumption grew by only 0.4 percent in 2007 and is projected to decline by 0.3 percent in 2008 before recovering with 0.8 percent growth in 2009.

### *Population*

Population growth is one of the primary drivers of growth in highway travel and motor gasoline consumption. The growth in U.S. population has generally slowed over the last several decades (Figure 3). Following a slowdown during the Great Depression and World War II, population growth accelerated during the 1950s to an average of 1.7 percent per year as a result of the baby boom and increases in life expectancy. Beginning in the mid 1960s, population growth began to slow, averaging 1.0 percent a year since 2000.

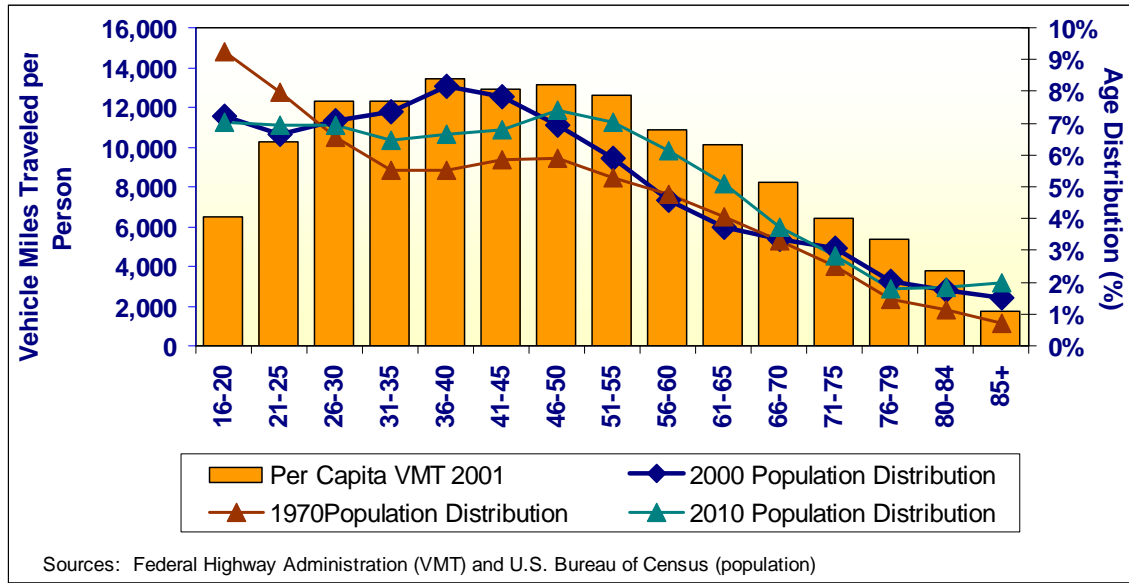
**Figure 3. U.S. Total and Driving Age Population (Millions) and Average Growth Rates, 1951-2007**



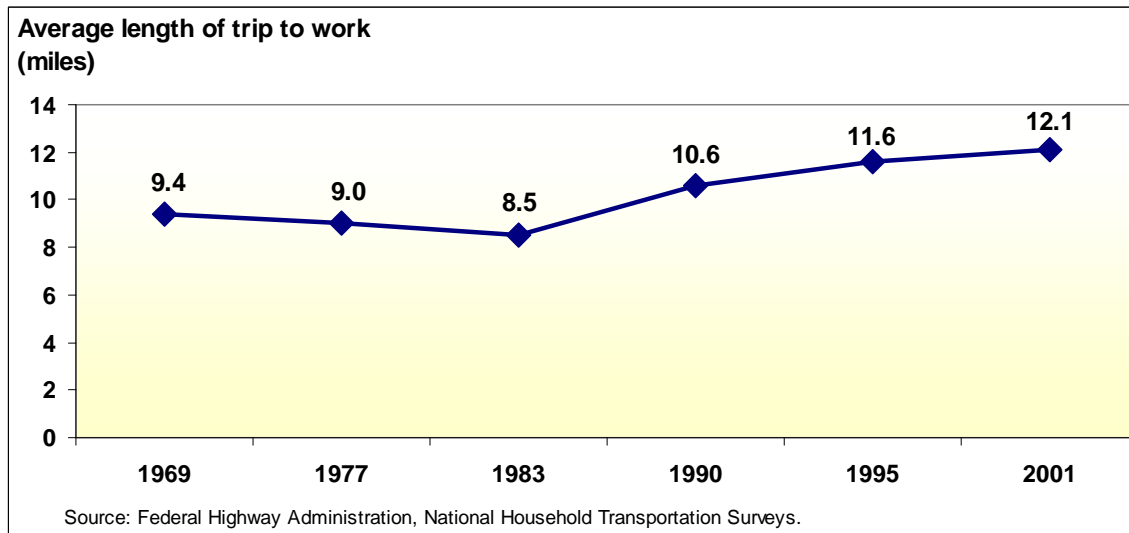
While the growth in population moderated, the median age of the population has risen, which is expected to boost highway travel and, hence, motor gasoline demand. Most driving is done by those between the ages of 26 and 55 (Figure 4). As the baby boomers aged, the proportion of the total population within these peak driving-demand years grew. For example, between 1970 and 2000, the share of the total population between 26 and 55 years of age increased from 35 percent to 43 percent. Based on the population distributions and per capita miles traveled in Figure 4, the aging of the population is estimated to have added about 0.4 percent to total miles traveled each year between 1970 and 2000. However, as the baby boom continues to age the shifting demographics are expected to slow the growth in average per capita miles traveled to less than 0.1 percent each year between 2000 and 2010.

Recent population growth has been greatest in the suburbs, which has resulted in an increase in the average length of the trip to work (Figure 5). Between 1995 and 2001, the average commuting distance increased by about 0.6 percent per year. Assuming that work comprises about 35 percent of total vehicle travel, this increase in average work-related commuting distance would add 0.2 percent to per-capita vehicle miles traveled each year.

**Figure 4. Age Distribution of Population and Per Capita Highway Travel**



**Figure 5. Average Commuting distances, 1969-2001**

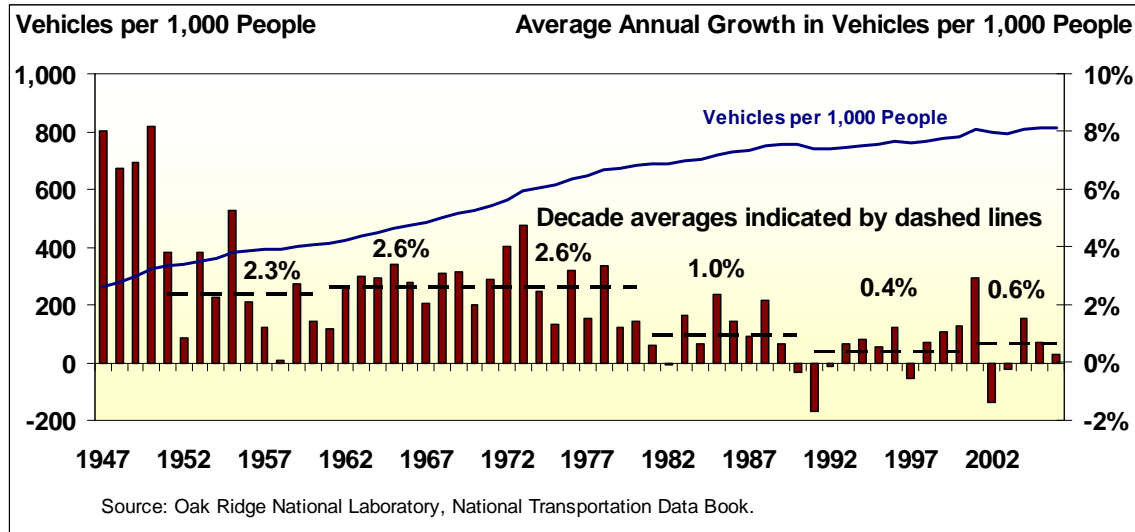


*Income*

Income growth has contributed to increased gasoline consumption in several ways. First, growing real income per household has led to increasing vehicle ownership. Between 1946 and 1990, the average number of total vehicles per

1,000 population grew steadily by an average of 2.6 percent per year (Figure 6).<sup>2</sup> Since 1990 the trend slowed to an average growth rate of 0.5 percent per year, which contributes to the slowdown in VMT. Figure 6 reveals not only the impact of overall income trends in vehicle ownership but also the dampening effects of recessions, such as those which occurred in 1980, 1981-82, 1990-91 and 2000.

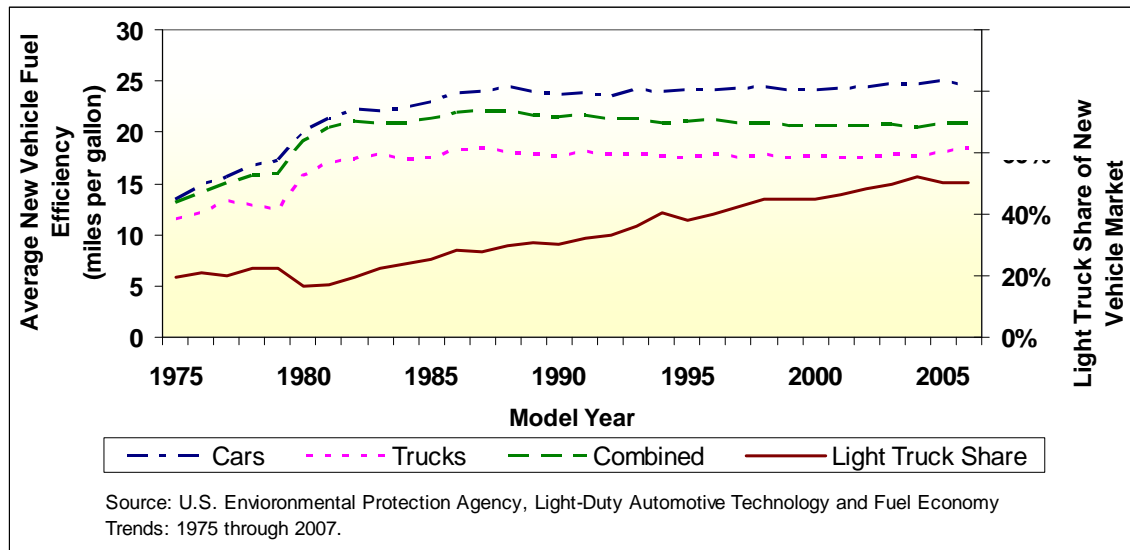
**Figure 6. Annual Average Growth in Vehicles per 1000 People in the United States, 1947-2006**



As growth in the number of vehicles per 1,000 people has slowed over the last 20 years, much of the continuing growth in real income has gone to the purchase of larger vehicles. The light truck share of the new passenger vehicle market has increased from about 20 percent in 1980 to over 50 percent today (Figure 7). The average fleet fuel efficiency of light trucks is about 25 percent lower than that of automobiles. But, rising gasoline prices over the last few years appear to have slowed that growth in the last 2 years.

<sup>2</sup> The count of total vehicles in this report includes non-passenger vehicles (i.e. trucks with more than 2 axles and 4 tires, combination trucks, and buses). Most gasoline-powered vehicles are passenger vehicles. Due to lack of data by vehicle type, data on the number of gasoline-powered vehicles are not available for years prior to 1963. However, the share of total vehicles accounted for by non-passenger vehicles (i.e. trucks with more than 2 axles and 4 tires, combination trucks, and buses) has been low, accounting for only 3.5 to 4.5 percent of all registrations. As a result, growth rates for gasoline-powered vehicles are generally very similar to those for total vehicles.

**Figure 7. Light Truck Market Share and Fuel Efficiencies, 1975-2006**

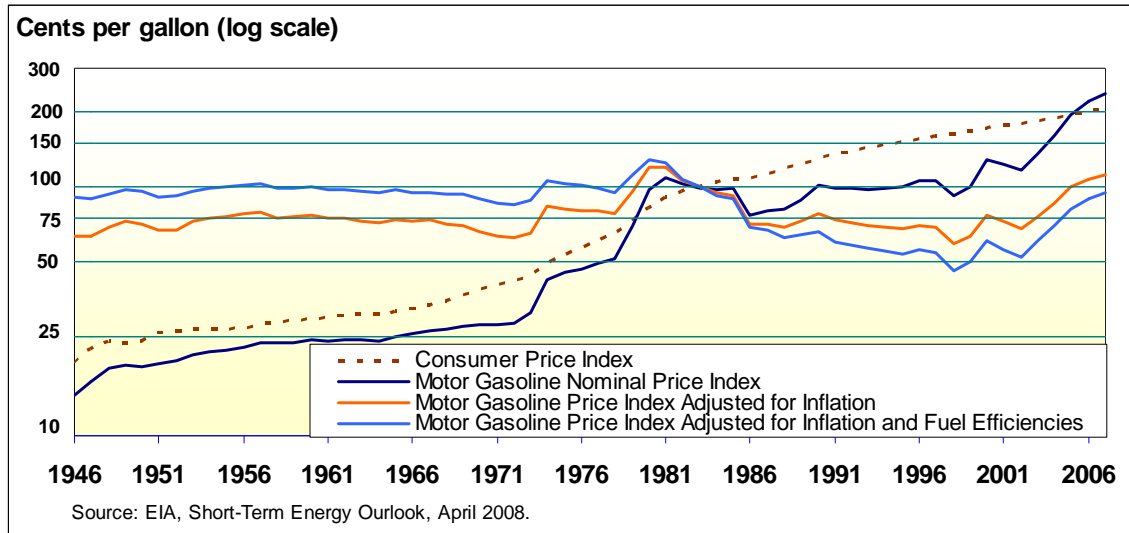


*Prices*

In addition to population and income, retail pump prices influence motor gasoline consumption. Substantial upward shifts in gasoline prices have been major factors in demand declines in several ways: they have directly reduced demand in the short term by reducing VMT, indirectly reduced demand by contributing to economic downturns, and influenced consumers to purchase smaller vehicles.

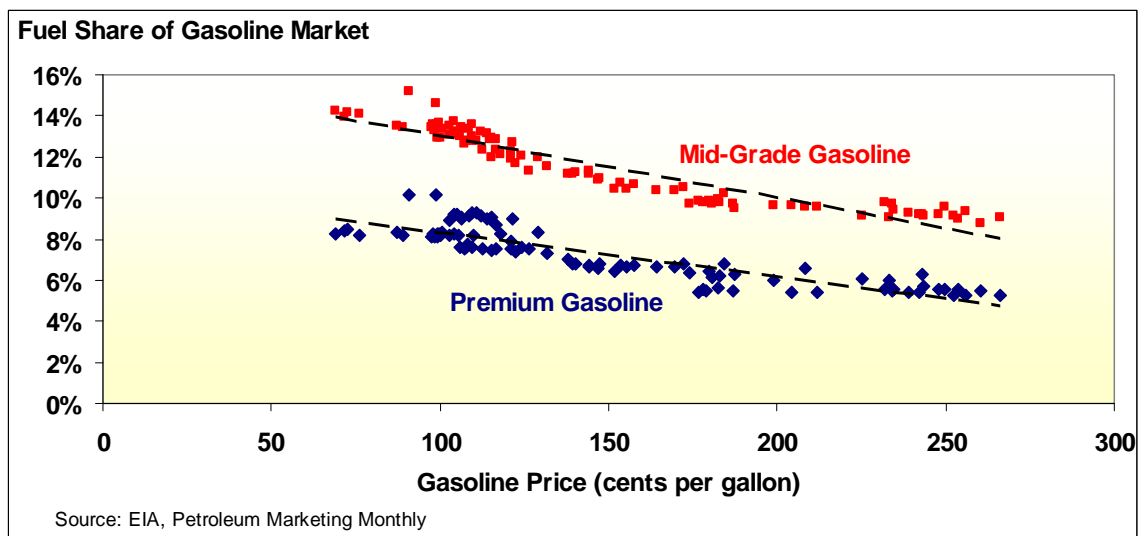
Figure 8 depicts motor gasoline price indices during the post-war period. For much of the period prior to 1973, average inflation-adjusted fuel costs declined even as pump prices rose steadily, contributing to the rapid growth of vehicle miles traveled and gasoline consumption. This phenomenon was also observed between the mid 1980s and most of the 1990s. During the last 3 years, however, fuel costs, even on an inflation-adjusted basis, have risen sharply and have constrained consumption.

**Figure 8. Motor Gasoline Price Indices, 1946-2007 (1982-84 = 100)**



Consumers have also adapted to rising prices by shifting to lower grades of motor gasoline (Figure 9). The market shares of midgrade and premium gasoline have been declining by an average 0.7 percent per year each, or about 1.4 percent total per year during that period. Assuming that the average price markup for midgrade and premium gasoline is 10 percent of the price of regular gasoline, and that total expenditures on gasoline are fixed, the money saved by switching to regular grade gasoline would therefore be equivalent to a 0.14 percent per year increase in total gasoline consumption.

**Figure 9. Midgrade and Premium Shares of the Motor Gasoline Market, January 2000-December 2007**



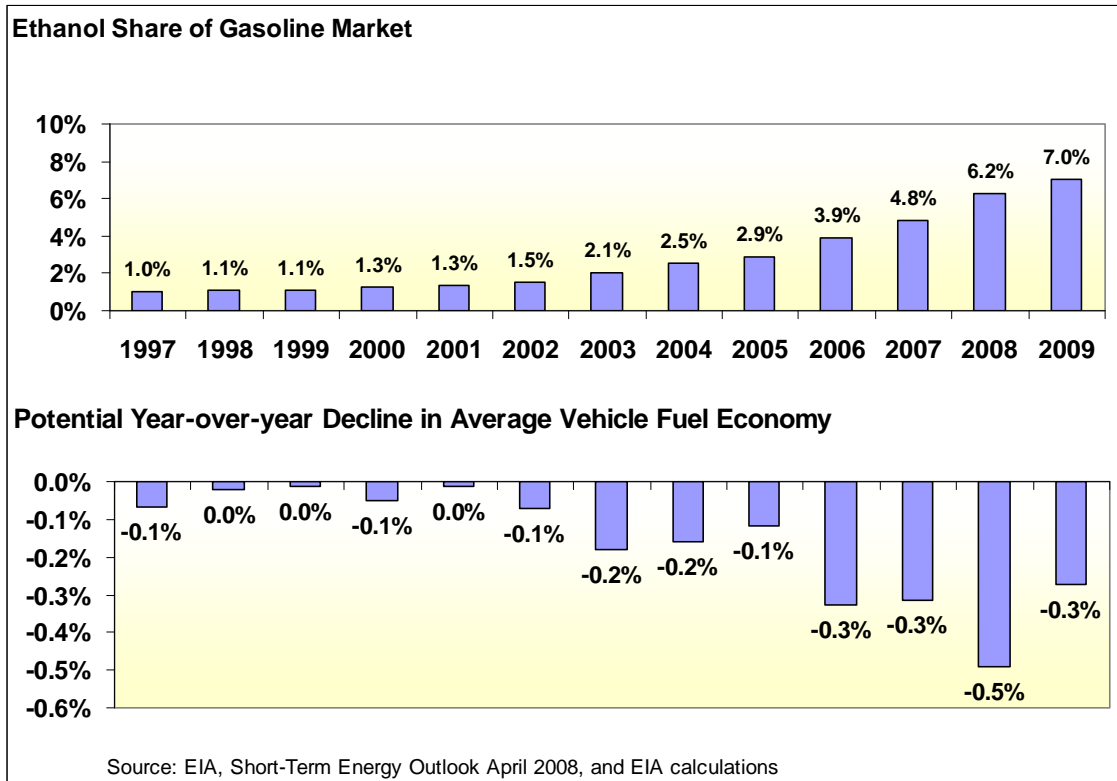


## *Ethanol*

Another factor affecting motor gasoline markets is the increase in the use of ethanol. Once regarded primarily as an oxygenate and an as a supplement to conventional gasoline consumed primarily in the Midwest, it has become a major fuel component intended to reduce the dependence on crude oil. The Energy Independence and Security Act of 2007 mandates the use of 9.0 billion gallons of renewable fuel in motor gasoline in 2008; 11.1 billion gallons in 2009 (a minimum of 0.6 billion gallons of the 2009 volume must be advanced biofuel); and 36 billion gallons by 2022 (with a 21 billion gallons advanced biofuel requirement). Fuel ethanol is expected comprise the bulk of that mandate.

The net energy content of ethanol is only 76,000 Btu per gallon compared to about 114,000 Btu per gallon for motor gasoline produced from crude oil refining. The increase in ethanol's share of the total motor gasoline pool will therefore reduce average automobile fuel efficiencies. In fact, the substantial increase in the ethanol market share projected for 2008 indicates that, even though motor gasoline consumption is projected to decline by 0.1 percent for that year on a volumetric basis, it is expected to decline by about 0.6 percent on a Btu basis (Figure 10).

**Figure 10. Impact of Ethanol of Average Vehicle Fuel Efficiency, 1997-2009**



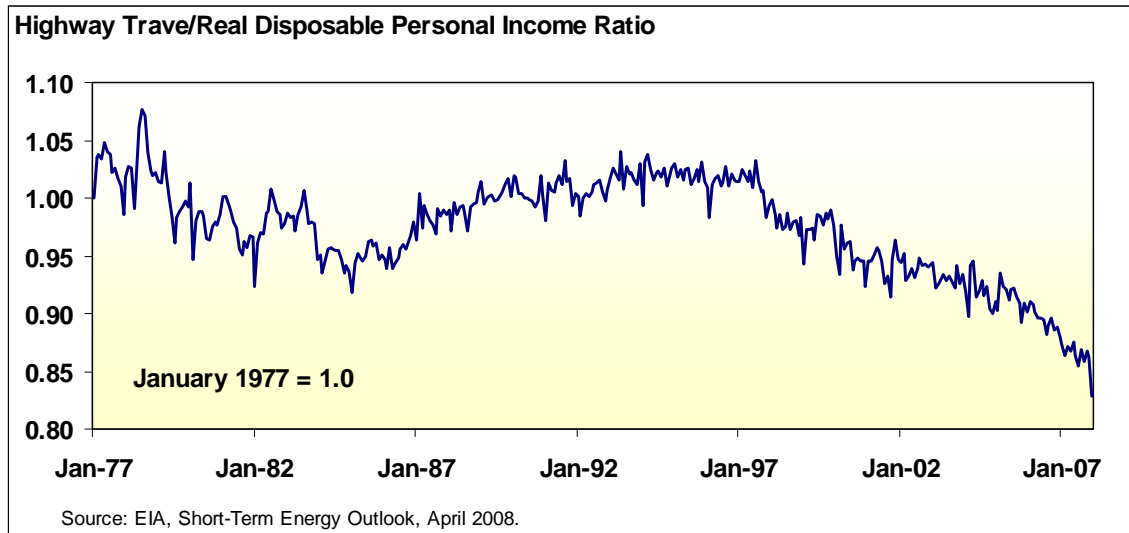
*The 1997 Shift in Motor Gasoline Markets*

Although the current economic slowdown and record retail prices have contributed to the current stagnation in gasoline markets, the slowing of consumption growth has been a feature of motor gasoline markets for at least 10 years. Not only has population growth slowed and the baby boomers are beginning to pass their prime driving years, but motor gasoline demand has also become less responsive to changes in real disposable personal income and fuel costs since 1997.

The reduced impact of income growth on motor gasoline demand growth can be seen in the ratio of gasoline-related VMT and real disposable personal income since 1977 (Figure 11). The figure reveals three distinct intervals. The first is from January 1977 to December 1986, during which highway travel growth trailed that of real disposable personal income. Prices fluctuated a great deal, depressing highway travel activity. During the second period, January 1987

through June 1997, growth in vehicle miles traveled outpaced that of real disposable personal income. Declining real fuel costs, which buoyed highway travel, account for most of the difference between the VMT and income growth rates during this period.

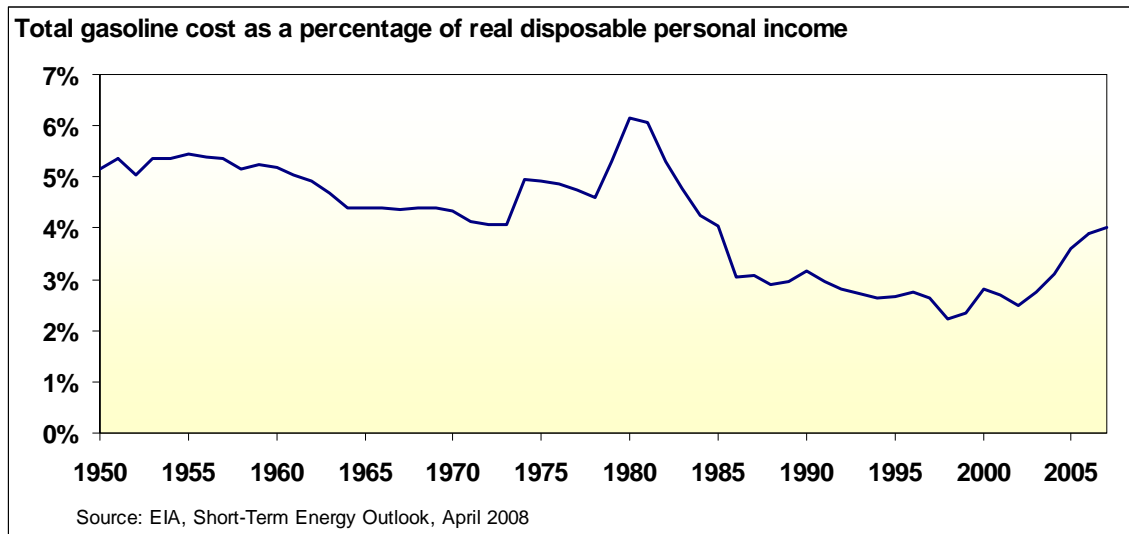
**Figure 11. Highway Travel/Real Disposable Personal Income Ratio**



During the third phase, July 1997 to October 2007, highway travel growth averaged 1.6 percent compared to 3.6 percent growth in real disposable personal income. As a result, the VMT-income ratio has declined during the past 10 years. This result obtains despite the record low real costs per mile recorded during the late 1990's. This period has also been characterized by substantially lower consumer responses to changes in fuel costs.

Part of the overall reduced response to price variation since 1997 results from the fact that fuel costs as a percentage of household income have declined during much of the post-war period. Figure 12 shows total motor gasoline costs as a percentage of disposable income. This suggests a dampening effect of the declining percentages on consumers' responses to price changes. This result occurred despite increases in per-capita miles driven until three years ago and recent increases in real fuel costs per mile.

**Figure 12: Motor Gasoline Cost as a Percent of Real Disposable Personal Income, 1950-2007**



The reduced impact of changes in income and prices during the post-1997 period results primarily from the fact that vehicle ownership is a mature market with the number of vehicles per capita nearing the saturation point.

In addition, the acceleration of the decline in the VMT/income ratio since 2004 is partly due increase in consumers' reaction at prices above \$2.50 per gallon. These results should be viewed with caution for three reasons. First, these estimates are tentative and are sensitive to revisions in the demand and VMT data. Second, the shift in consumer behavior might be temporary, indicating a resumption of stronger-than-projected demand when the current recession ends, even if the higher prices were to persist. This has happened in previous instances when prices rose substantially for extended periods of time. Third, the heightened price elasticity at prices above \$2.50 per gallon is still well below the average price elasticity that prevailed prior to 1997 (Table 1).

Separate regressions reveal substantial differences in the income and price effects between the pre- and post-1997 periods, which are summarized for the second and third periods in Table 1. The table shows that the impact of changes in income was reduced by more than half in the latter period, and that the impact of variations in fuel costs in the latter period was only a fraction of those during the earlier period, even when prices exceed \$2.50 per gallon. It should be emphasized, however, that the fuel price impacts are only short-term estimates.

The high-frequency (monthly) nature of the data precludes the estimation of the impacts of price changes over long-term intervals.

Table 1. Estimated Motor Gasoline Demand Regression Coefficients (Elasticities)

	January 1987 to June 1997	July 1997 to October 2007
Income	1.14	0.48
Fuel Costs		
Prices up to \$2.50/gallon	- 0.065	- 0.011
Prices above \$2.50/gallon	n/a	- 0.020

Source: EIA, Short-Term Energy Outlook.

### *Conclusion and 2008 Summer Outlook*

Many of the socio-economic factors that drove gasoline consumption growth to average over 4 percent a year in the 1950s and 1960s do not have the same influence today. For example, population growth has slowed from 1.6 to 1.0 percent a year; the baby boomers are beginning to pass the peak driving years; and the market for automobiles has approached saturation so that income growth no longer drives an increase in the average number of vehicles per capita, which averaged over 2 percent a year up until the late 1970s.

Also slowing growth in gasoline consumption is the doubling of retail gasoline price over the last 3 years. The last time we experienced such a dramatic increase in prices was following the Iranian revolution in 1979. It was price increase in 1979 and 1980 that motivated consumers to buy more fuel-efficient cars. While we find the consumer response to gasoline price increases is now smaller, the recent price surge is nevertheless beginning to show up in lower gasoline consumption.

Finally, we can see that the slowing U.S. economy is also affecting gasoline consumption. However, estimating the effects of recessions is difficult because of the few comparable datapoints. In the recession year of 2000, for example, annual gasoline consumption registered consumption growth of 0.5 percent compared to 2.1 percent in 1999. But 1990 and 1991 witnessed year-over-year

declines in consumption of 1.7 percent and 0.7 percent, respectively, due to the recession and the oil price spike brought about by the Persian Gulf conflict.

During the first half of 2007, consumption was up by 0.9 percent compared to the same period in 2006. During the second half of the year, however, it declined by 0.1 percent. A closer look at the second half reveals that the weakness in demand accelerated during the fourth quarter, during which average consumption declined 0.4 percent compared to the same period last year. Retail regular pump prices averaged \$2.97 per gallon during the fourth quarter 2007 compared to \$2.26 per gallon during the same period in 2006.

Available data for 2008 show a further acceleration in the decline of motor gasoline demand. For the first 3 months of the year, consumption is estimated to be about 0.6 percent lower than during the same period in 2007. During that period, personal disposable income rose only an estimated 0.3 percent. Regular grade gasoline retail prices have averaged \$3.11 per gallon compared to \$2.36 per gallon during the same period the previous year.

For the summer season, which comprises the second and third quarters of 2008, motor gasoline consumption is projected to average 9.40 million barrels per day (bbl/d), down 0.4 percent from that of the previous summer. Adjusting for the reduced Btu content of the growing ethanol share of the motor gasoline pool, the year-to-year decline in would be closer to 0.9 percent. The temporary boost to real disposable personal income from the upcoming economic stimulus payments, which accounts for the bulk of the year-to-year growth in real disposable personal income during the second quarter 2008, is not expected to have much effect on motor gasoline demand.

The weakness in gasoline consumption is expected to continue, even as the economy recovers from its current slowdown and prices begin to subside. For the foreseeable future, demographic shifts, the impact of high prices on vehicle efficiency, and the more recent shift characterized by reduced impact of income on vehicle miles traveled are likely to keep growth in gasoline consumption well below that seen for much of the post-war period.