Fuel Prices in Travel Demand Models

presented to
MWCOG/NCRTPB Travel Forecasting Subcommittee

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Introduction

- **Fuel prices had more than doubled since 2003, before recent slowdown occurred.**
- **What are the effects of sustained high fuel prices on travel behavior?**
- **How do we incorporate effects of fuel price changes in travel demand models?**

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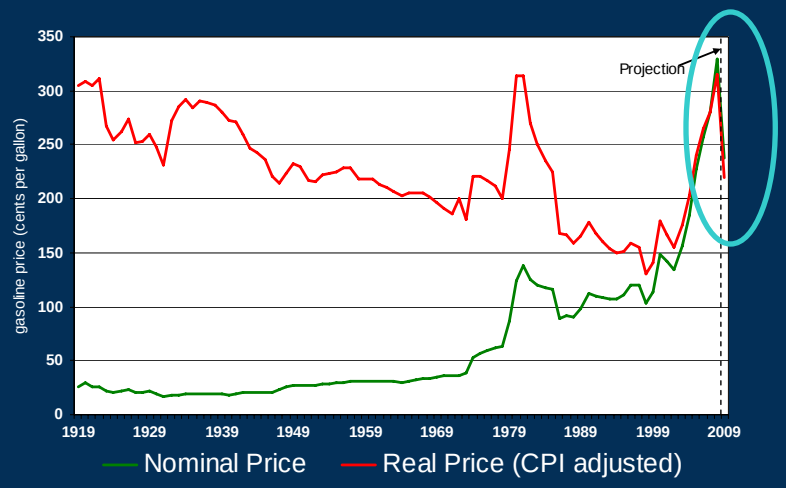
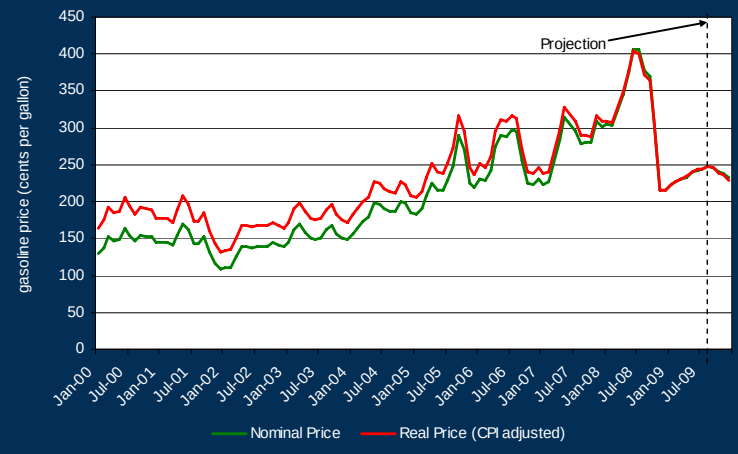
Average Annual Retail Gasoline Price



2 (Source: http://www.eia.doe.gov/emeu/steo/pub/fsheets/real_prices.xls)

Average Monthly Retail Gasoline Prices



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Effects of Fuel Price Increases

- How much less are people driving?

> ***"Vehicle miles traveled measured 708 billion in the United States during the first quarter of 2008, a decrease of 2.3% compared to the same period last year." -*** **Farmers Insurance quarterly update**

> ***The American Public Transportation Association's June 2 news release reported that transit ridership (boardings) was up 3.3% for the first quarter [of 2008], compared with last year.***

But all other things are not equal from 2007 to 2008!

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Effects of Fuel Price Increases (2)

- 1970s fuel price increase saw significant behavioral response
  - Reduced driving and fuel consumption
  - Move towards more fuel efficient vehicles
  - Shift in travel mode
  - Change in residential location choice
- Recent fuel price increase has not induced similar behavioral responses
  - While a 20 percent increase in fuel price resulted in 6 percent less consumption in 1970s, it yielded only 1 percent decrease during recent price increase
  - Improvement in average fuel efficiency has been negligible

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Factors affecting Fuel Price Sensitivity

- Trip characteristics
  - Work and peak period trips are less elastic than shopping/recreational and off-peak period trips, respectively
- Traveler characteristics
  - High income and business travelers are less sensitive to price changes
- Time Period
  - Short-term response to fuel price increase is considerably different from long-term responses
  - Long-term elasticities are in general 2 to 3 times higher than short-term elasticities
- Quality and price of other alternatives

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Demand Elasticity with respect to Fuel Price

- Key travel demand components affected by fuel price
  - Vehicle ownership
  - Fuel consumption and efficiency
  - Vehicle miles traveled
  - Transit ridership

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Vehicle Ownership

- In response to prolonged high fuel prices, consumers are likely to move towards a more fuel efficient vehicle fleet
- Market share of light trucks has decreased from 53 to 48.3 percent in the last year
- A 20 percent increase in fuel price would increase the market share of cars (against light trucks) by 2.6 percent (CBO, 2008)
- Vehicle ownership elasticity ranges between -0.63 to 0.03 (Goodwin et al., 2004)

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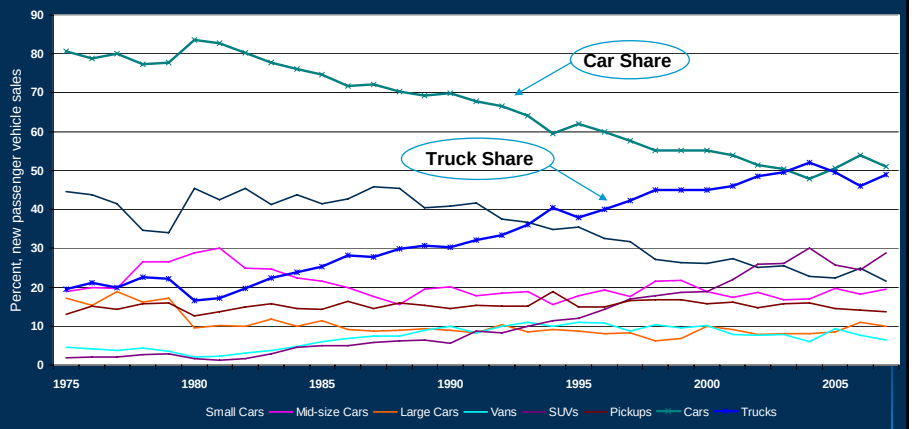
Passenger Vehicle Market Shares



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(Source: http://epa.gov/otaq/cert/mpg/fetrends/420r08015.pdf**)**

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Fuel Consumption and Efficiency

- Fuel efficiency improvements in new passenger vehicle fleet partially compensates for the fuel price increase in the long run
- Elasticity of fuel efficiency with respect to fuel price ranges from -0.031 in short run to -0.45 in long run (Litman, 2008; Small and Van Dender, 2007)
- Fuel consumption elasticity ranges from -0.074 to -0.8 in the short and long run, respectively (Small and Van Dender, 2007; Graham and Glaister, 2002)

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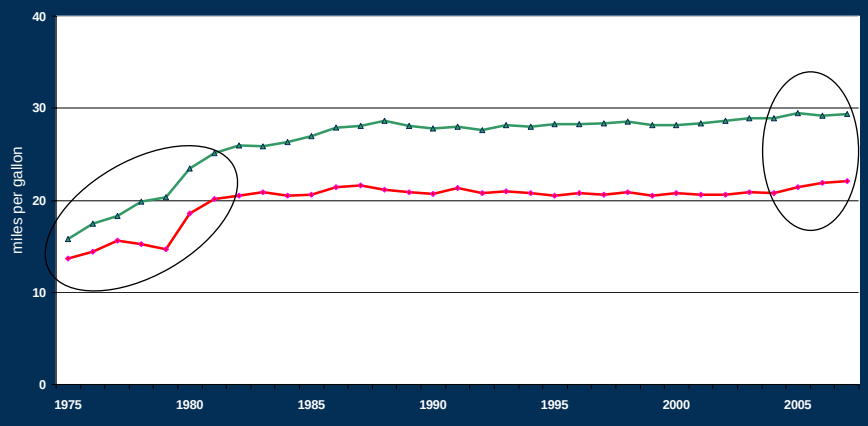
Fuel Efficiency



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Vehicle Miles Traveled (VMT)

- Total highway travel has grown steadily at an average of 3.2 percent annually during 1970 – 1995 and at 2.1 percent during 1995 – 2005 (Small and Van Dender, 2007)
- VMT is relatively insensitive to fuel prices
- Per capita VMT has been decreasing during last three years in California and could be up to 3 percent less in 2008 as compared to 2007 (SACOG, 2008)
- Overall health of economy plays a significant role in changes in VMT and can not be attributed to fuel price changes alone
- VMT elasticity ranges from -0.05 in the short run to -0.63 in the long run (Goodwin et al., 2004)

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Transit Elasticities

	Short-term	Long-term
Transit ridership wrt transit fare (peak)	-0.15, -0.3	-0.4, -0.6
Transit ridership wrt transit fare (off-peak)	-0.3, -0.6	-0.8, 1.0
Transit ridership wrt auto operating cost	0.05, 0.15	0.2, 0.4
Automobile travel with respect to transit fare	0.03, 0.1	0.15, 0.3

(Source: Litman, 2008)

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Fuel Prices and Travel Demand Models

- State-of-the-practice
  - Fuel price is a component of auto operating cost which appears in most mode choice models
  - Auto operating costs typically consists of fuel cost, wear and tear cost, and maintenance costs
  - Fuel price is a small component of auto operating costs and hence, a spike in fuel price does not change auto operating costs significantly
  - TPB model uses a fixed 10 cents per mile (1994 dollars) value as auto operating cost
  - A fixed auto operating cost is a big simplifying assumption in the wake of highly unstable fuel prices

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Potential Travel model Considerations

- Changes in land use patterns
- Reduction in total trips
- Increased trip chaining
- Changes in trip lengths
- Increased transit patronage

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Potential Travel model Considerations (2)

- Changes in household expenditure patterns
- Changes in fuel efficiency
- Increased transit costs
- Changes to toll road usage
- Changes in the departure/arrival times

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Viability of Modeling Long-term Impacts

- It is hard to predict even tomorrow's fuel prices
- The fuel prices have to remain high for a prolonged period to observe behavioral shifts
- Most behavioral changes occur in the long run
- Data to analyze effect of current fuel price increase is not yet available
- Changes in fuel prices are often connected with the overall health of the economy and hence traveler's responses can not be attributed to fuel prices alone

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Modeling the Effect of Fuel Prices

- Forecasting future fuel prices
  - Delphi approach
  - Adjusting forecasts based on the rate of inflation
  - Linear regression
  - Sophisticated econometric models
  - Or just use the base year fuel price (most widely accepted practice)

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Modeling the Effect of Fuel Prices (2)

- Modeling approaches
  - Integrated microsimulation-based land use and transportation model
  - Development of reasonably robust models and reliance on professional judgment
  - Employing a multi-scenario analysis to forecast probable future

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Conclusions

- Fuel prices are too unpredictable to forecast
- Insufficient data to model behavioral response to fuel price increase
  - Lag in travelers' response coupled with fluctuating fuel prices makes data collection exercise difficult
- Key to modeling approach
  - Identifying and accounting for the uncertainty involved
  - Developing a spectrum of future forecasts based on different forecast scenarios
  - Acknowledging the limitations of the forecasts

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