Speeding Behavior and Gasoline Prices using hourly Washington state data

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Research Question

Primary Question:

- Do drivers seek to conserve gasoline by reducing speeds in times of high gasoline prices?

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Secondary Questions:

- Is this speed reduction homogenous across speed ranges?
- Do they respond to the price signal at pump or media attention?

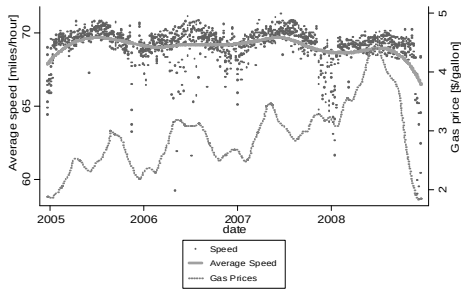
Previous Research

- Peltzman (1975), Dahl (1979), Blomquist (1984), US GAO (2008)
  - Yes, speeds decrease with rising gas prices
  - Mostly used annual U.S. traffic speed data
- Burger and Kaffine (2009)
  - Measured using weekly speed data in Los Angeles
  - With *rising* gas prices, speeds *increase*
  - Higher gas prices decrease congestion

Study Data

- 8 sites in rural Washington state
- 70 mph speed on straight flat continuous low traffic sections
- January 3, 2005 to December 31, 2008
- 5 combined datasets
  - Hourly speed data (WSDOT)
  - Hourly temperature, precipitation and visibility (NOAA)
  - Weekly average gasoline prices (DOE)
  - Monthly local unemployment rate statistics (Bureau of Labor Statistics)
  - Per capita personal income (Bureau of Economic Analysis)
- Each hour WSDOT records all vehicles passing over the loop detectors and quantifies speeds in five mile per hour (mph) increments from 35 mph to above 100 mph

Avg Speed (per week) and Gas Prices



Dataset Refinement

- Hourly speed data (rather than weekly)
- Data filtered (dropped) for any hour and site with
  - Average speed < 67 mph
  - NOAA variable 'visibility' of < 10 mi
  - Within 2 hours of rain
  - Temperature ≤ 32 degrees Fahrenheit

Regression Equation

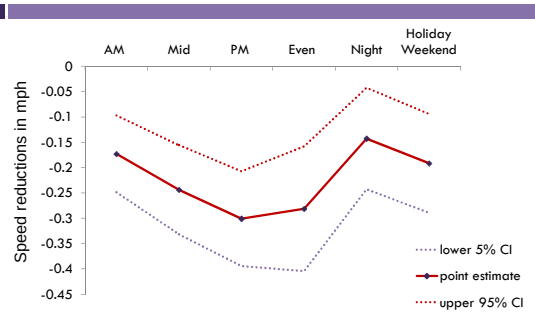
$$Speed_{ih} = \alpha + \beta * price_t + M_t + Y_t + F_i + \gamma X_{it} + \varepsilon_t$$

Speed = avg speed at hour *h* and site *i*,
$price_t$ = weekly average gas price,
F_i = freeway site fixed effects,
Y_t = year fixed effects
X_{it} = precipitation, holiday, summer dummies & income, unemployment

Regression Results

Coefficient	Basic Model (Month, Site & Year fixed effects)	Basic Model & Hour Fixed Effects	Basic Model & Hour & Work and Non-work time Fixed Effects
Gas price	-0.16***	-0.17***	-0.19***
	(0.048)	(0.048)	(0.036)
Months	***	***	***
Hours / Timeblocks		***	***
Constant	70.0***	71.0***	70.7***
	(0.19)	(0.20)	(0.14)
Observations	138,162	138,162	138,162
Adjusted R^2	0.06	0.36	0.54

Speed Reduction due $1/gal increase



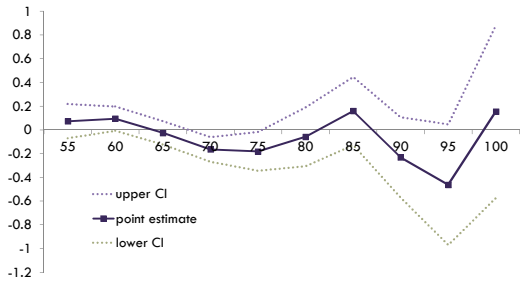
Gas Price vs Speed Relationship (PM)

Coefficient	Basic Model	Interacted Fixed Effects Model	Interacted Fixed Effects Model w/ unemployment & income
Gas price	-0.29***	-0.25***	-0.27***
	(0.053)	(0.049)	(0.048)
Unemployment			-0.15***
			(0.055)
Income			0.0001***
			(0.000)
Constant	71.2***	71.1***	68.3***
	(0.21)	(0.19)	(1.59)
Observations	9,390	9,390	9,390
Adjusted R^2	0.27	0.37	0.38

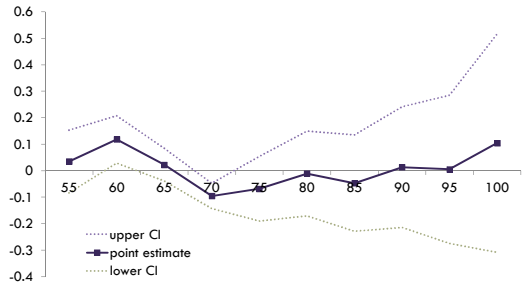
Impact of Gas Price on Speed Distributions

- Vehicles traveling 75 mph consume 24% - 34% more gasoline compared to 55 mph (Davis 2010)
  - Do high gasoline prices effect these fast drivers overproportionally?
  - Or do these drivers enjoy speeding on its own, irrespective of the price of gas?
- Bin percentile regressions of the proportion of vehicles in each hour in 5 mph increments.

%tile Speed vs Price of Gas (PM)



%tile Speed vs Price of Gas (24 hrs)



Information Effects

- Are changes in speed influenced by the price at pump or public media attention?
- Number of times the term "gas price" occurred in Seattle Times and NY Times counted by week

Prices vs. Information Effects (PM)

Variables	Basic Model	Basic & Seattle News Model	Seattle w/o gas price regressor	Basic & NY Times News Model	NY Times w/o gas price
Gas price	-0.27***	-0.23***		-0.18***	
	(0.048)	(0.053)		(0.052)	
NY Times				-0.0097***	-0.0128***
				(0.002)	(0.002)
Seattle Times		-0.0024	-0.0046***		
		(0.002)	(0.002)		
Constant	68.3***	68.4***	84.4***	67.6***	83.8***
	(1.59)	(1.56)	(0.79)	(1.51)	(0.77)
Observations	9,390	9,390	9,390	9,390	9,390
Adjusted R^2	0.375	0.375	0.372	0.377	0.376

Conclusion

- Do drivers seek to conserve gasoline by reducing speeds in times of high gasoline prices?
- Is this speed reduction homogenous across speed ranges?
- Do they respond to the price signal at pump or media attention?

Conclusion

- Do drivers seek to conserve gasoline by reducing speeds in times of high gasoline prices?
  - $1 increase in gas prices reduces avg speed by 0.27 mph
- Is this speed reduction homogenous across speed ranges?
  - Reduced most in the range of 70 to 80 mph
  - Fast drivers (above 85 mph) reduce speeds under-proportionately
  - Gasoline tax targeting safety has limited effects
- Do they respond to the price signal at pump or media attention?
  - Price at the pump dominates

Future Research

- Results may not be generalizeable to other areas of the country
  - Psychology of driving patterns and usage habits
  - Replication in other locations
- Critical to use hourly speed data

Thanks!

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