



CONSUMER CHOICE AND THE WELFARE IMPACTS OF CAFE STANDARDS

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Cost and Benefit Estimates
Passenger Cars and Light Trucks Combined
7% Discount Rate

	MY 2012	MY 2013	MY 2014	MY 2015	MY 2016	Total
Technology Costs	\$5,902	\$7,890	\$10,512	\$12,539	\$14,903	\$51,748
Benefits						
Lifetime Fuel Expenditures	\$7,197	\$15,781	\$22,757	\$29,542	\$36,727	\$112,004
Consumer Surplus from Additional Driving	\$542	\$1,179	\$1,686	\$2,163	\$2,663	\$8,233
Refueling Time Value	\$567	\$1,114	\$1,562	\$1,986	\$2,379	\$7,608
Petroleum Market Externalities	\$432	\$917	\$1,296	\$1,654	\$2,023	\$6,322
Congestion Costs	(\$355)	(\$719)	(\$1,021)	(\$1,302)	(\$1,595)	(\$4,992)
Noise Costs	(\$7)	(\$14)	(\$20)	(\$26)	(\$31)	(\$98)
Crash Costs	(\$173)	(\$342)	(\$488)	(\$619)	(\$756)	(\$2,378)
CO ₂	\$921	\$2,025	\$2,940	\$3,840	\$4,804	\$14,530
CO	\$0	\$0	\$0	\$0	\$0	\$0
VOC	\$32	\$60	\$80	\$99	\$119	\$390
NOX	\$53	\$80	\$98	\$114	\$131	\$476
PM	\$154	\$336	\$480	\$611	\$748	\$2,329
SOX	\$125	\$265	\$373	\$475	\$581	\$1,819
Total	\$9,490	\$20,682	\$29,742	\$38,538	\$47,791	\$146,243
Net Benefits	\$3,587	\$12,792	\$19,230	\$25,998	\$32,888	\$94,495

2010 CAFE FRIA

Total Benefits:
\$146 billion

Externalities:
\$18 billion

“Internalities”:
\$128 billion

Net Benefits:
\$94 billion

Net Benefits (w/o Internalities):
\$ -33 billion

NHTSA's Introduction

"Although the economy-wide or "social" benefits from requiring higher fuel economy represent an important share of the total economic benefits from raising CAFE standards, NHTSA estimates that benefits to vehicle buyers themselves [original emphasis] will significantly exceed the costs of complying with the stricter fuel economy standards this rule establishes However, this raises the question of why current purchasing patterns do not result in higher average fuel economy, and why stricter fuel efficiency standards should be necessary to achieve that goal. To address this issue, the analysis examines possible explanations for this apparent paradox, including discrepancies between the consumers' perceptions of the value of fuel savings and those calculated by the agency"

-CAFE Standard Final Regulatory Impact Analysis (2010)

Observations

- Many people think that CAFE standards are about reducing externalities.
- CAFE Regulatory Impact Analysis: the paternalistic rationale for CAFE is potentially much more important from a welfare perspective.
- Basic intuition/calibration:
 - At \$21 per ton CO₂ (US Gov't 2010): Uninternalized externality from climate change is \$0.18 per gallon, or 5-10% of gas price
 - “Some analysts” think that consumers undervalue gasoline costs by 20-30%.
 - Both externalities and “internalities” cause consumers to purchase too many gas guzzlers relative to the social optimum
 - But the internality effect could be 2-6 times larger!
- Takeaway: There is a lot of work on climate change and “traditional” externalities. Need more on internalities.

Two Basic Questions

1. Empirical: Do consumers indeed buy vehicles that are less energy efficient than their *private* optimum?
 1. If not, we should only count *externalities* in cost-benefit calculations.
 2. And we should favor Pigouvian taxes (Jacobsen 2011).
2. Theory/simulations: If so, what are the policy implications and welfare effects?

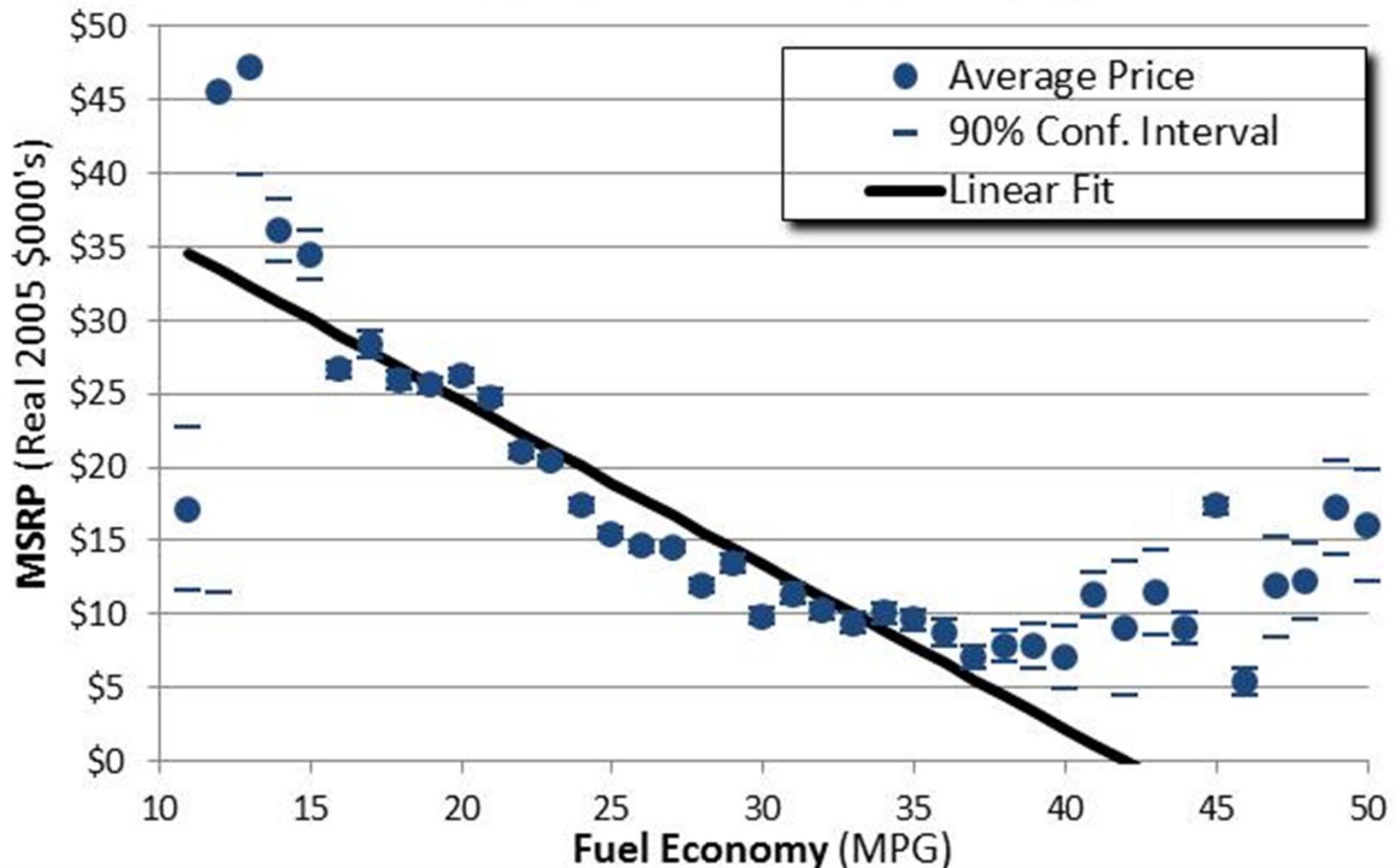
- This presentation draws on joint work with Sendhil Mullainathan (Harvard), Rich Sweeney (Harvard), Todd Rogers (Harvard), Nathan Wozny (Mathematica), Dmitry Taubinisky (Harvard), and Michael Greenstone (MIT).
- Thanks to the Sloan Foundation and MacArthur Foundation for financial support.

Question 1: Estimating Inattention

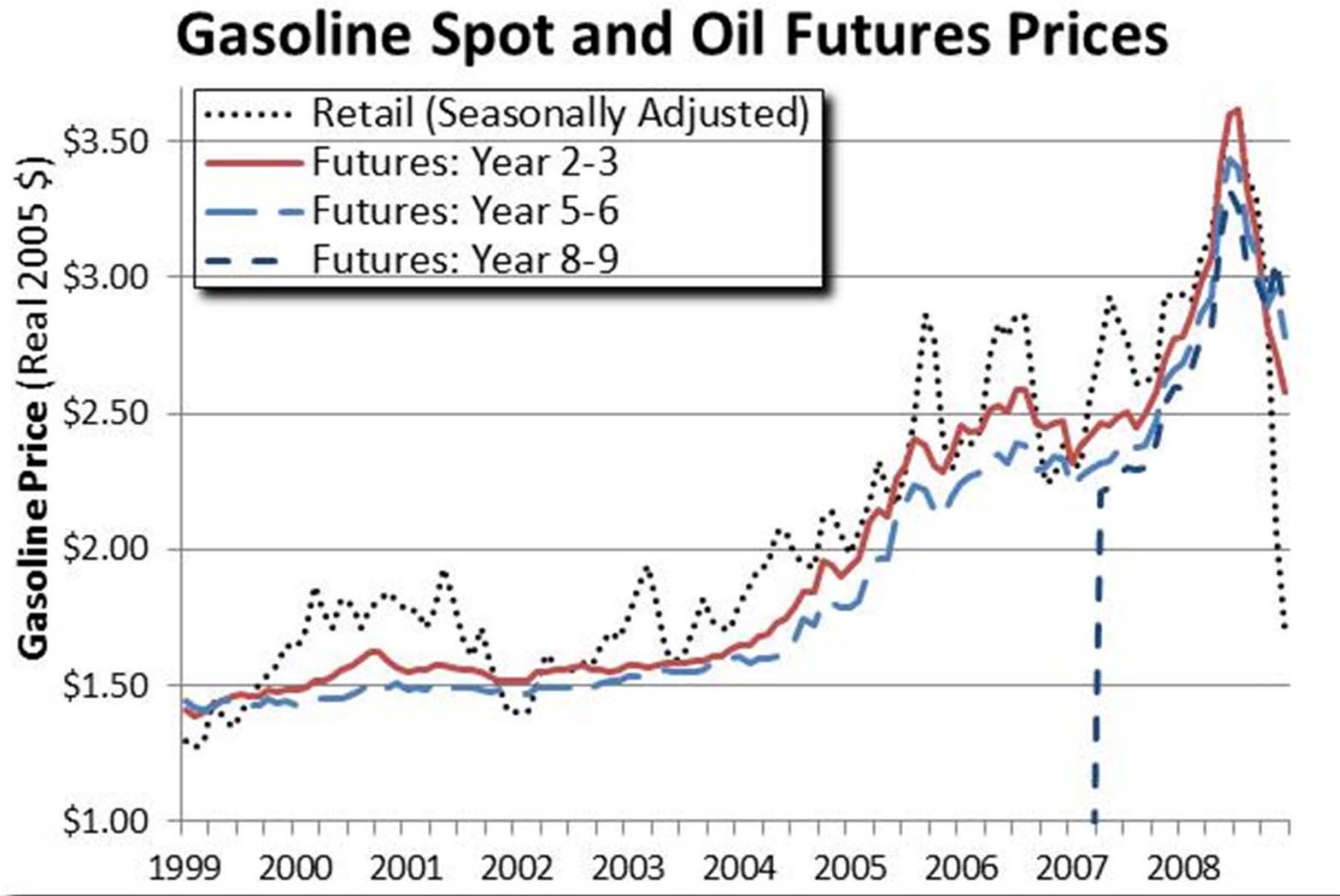
- Empirical: Do consumers buy vehicles that are less energy efficient than their *private* optimum?
- Example: Hybrid car saves you \$5000 in NPV. Are you willing to pay \$5000 more for it?
- Empirical challenges:
 - Measurement error
 - NPV calculation parameters: discount rates, expected gas prices, time horizons, survival probabilities, etc.
 - **Unobserved costs.**

Estimating γ for the U.S. Auto Market

Price vs. MPG: 1984-2008

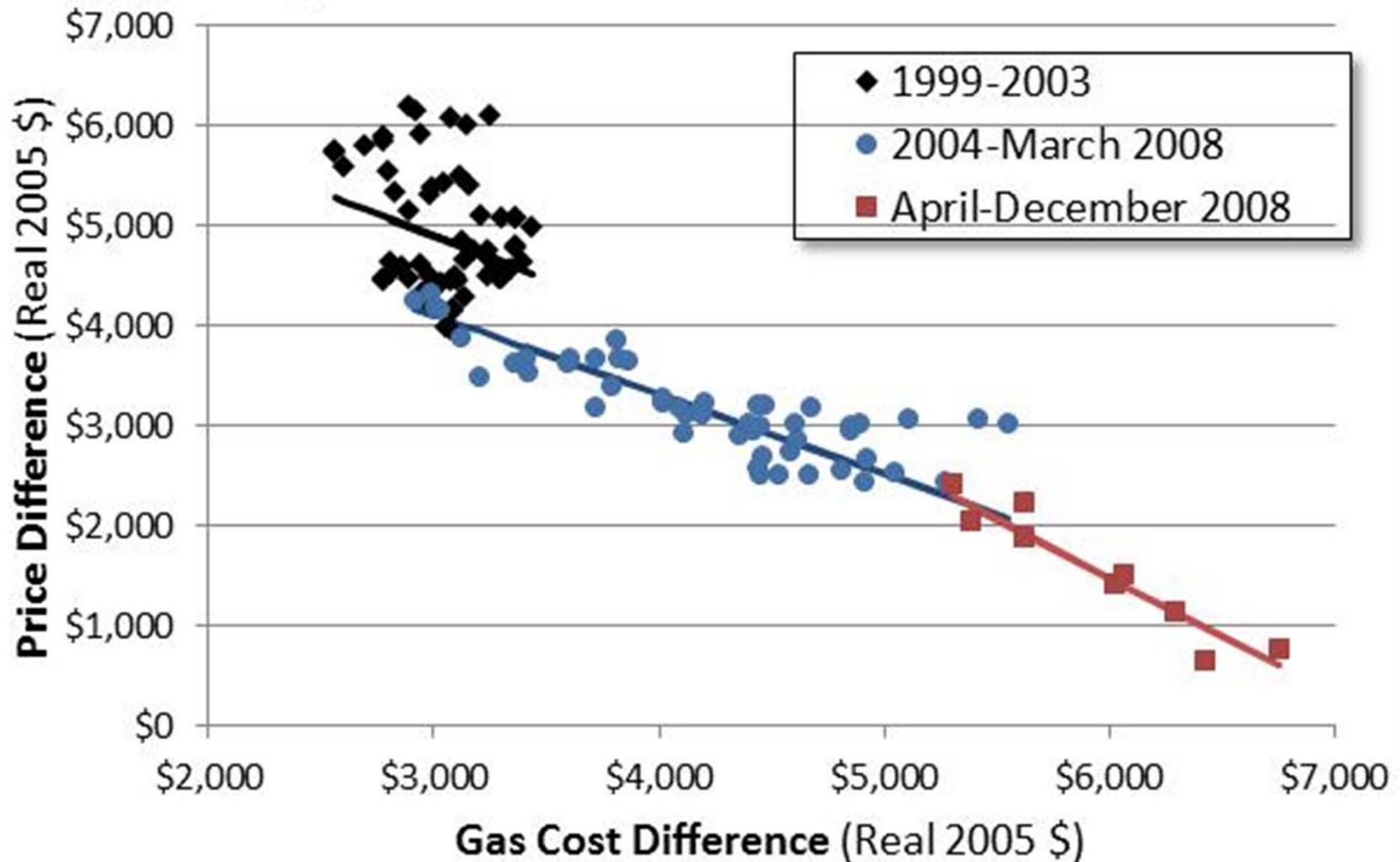


Using Time-Series Variation in Gas Prices

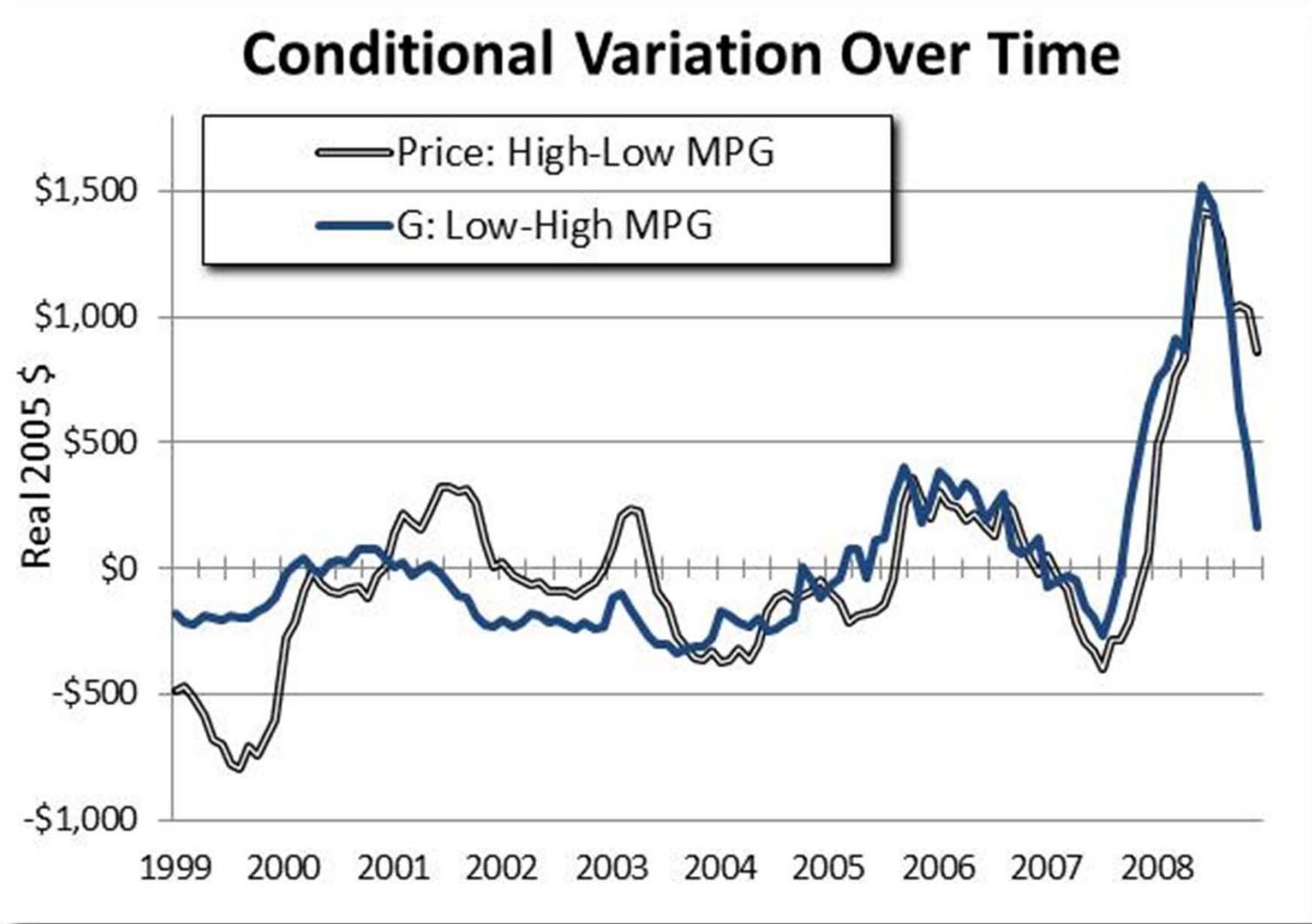


How Auto Prices Adjust

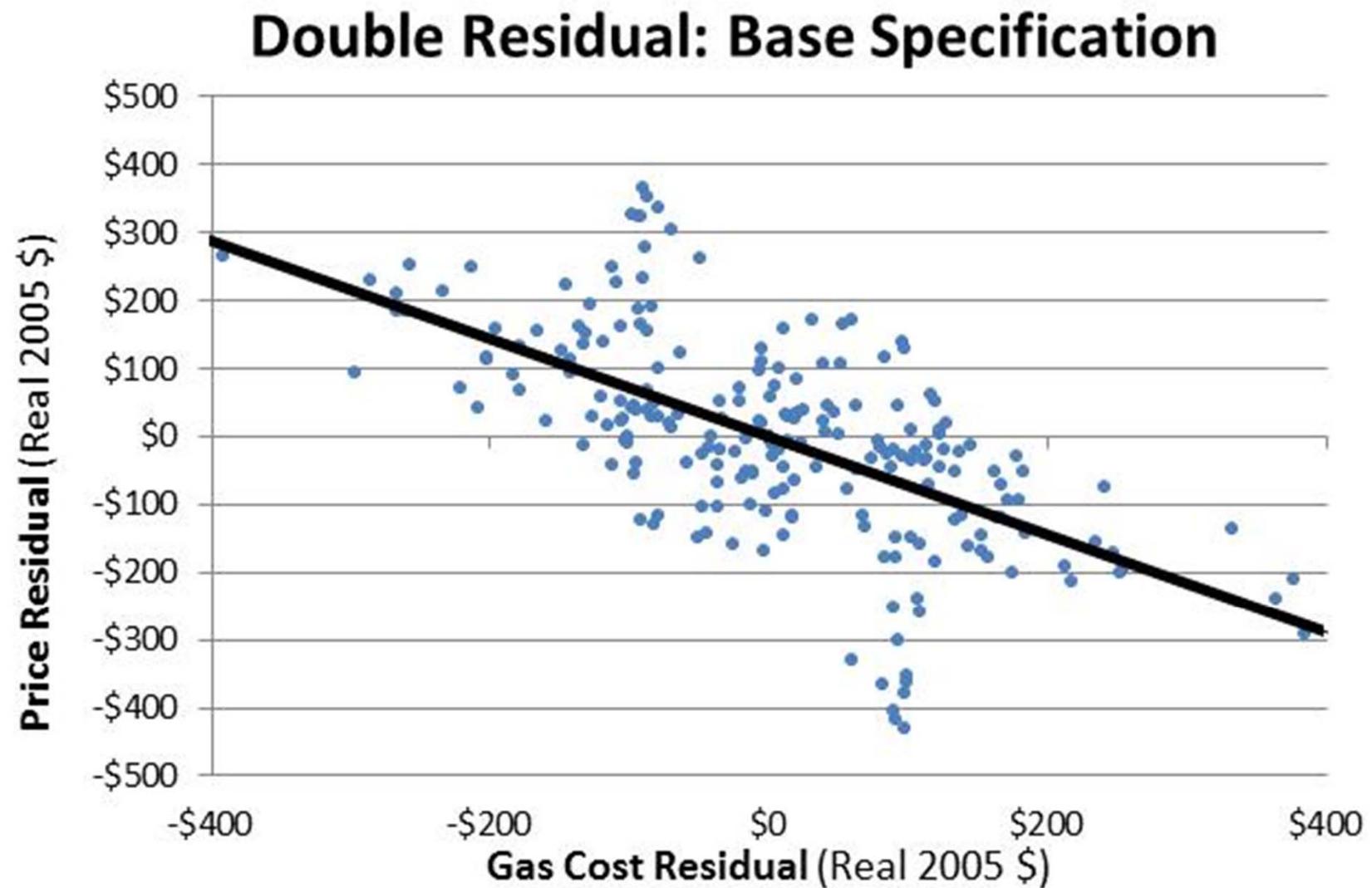
High-Low MPG Price and Gas Cost



Variation Net of Controls



Partial Regression Plot



Takeaways

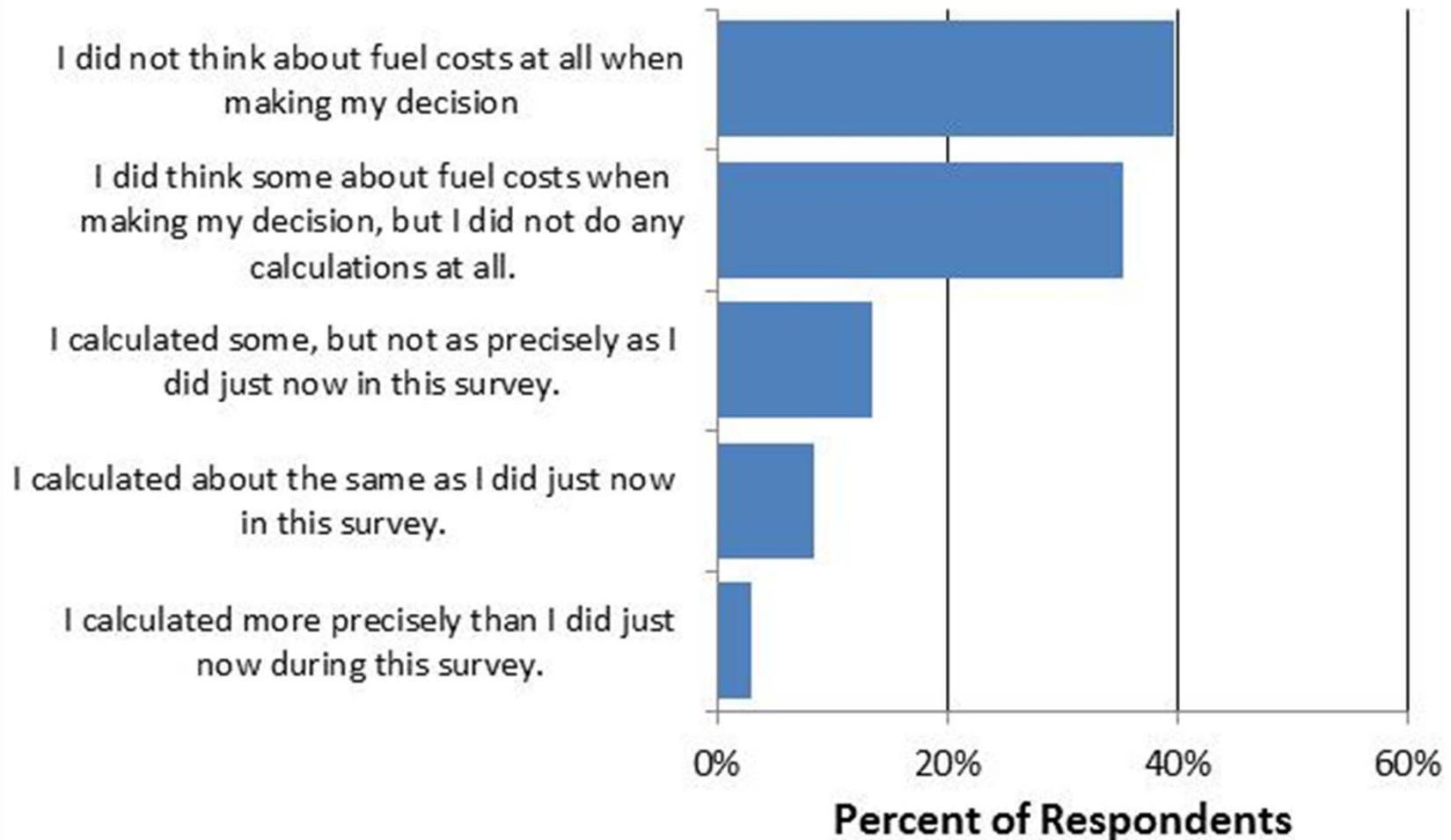
- Preferred specification: $\gamma = 0.72$.
 - Emphasize that alternative specifications make a difference.
 - E.g. discount rates, time period analyzed
- Other related empirical projects:
 - Sallee, West, and Fan (2011).
 - Empirical estimates in process.
 - Busse, Knittel, and Zettelmeyer (2011).
 - Corrected results (for used car market) now consistent with Allcott/Wozny preferred specification.
 - New car market results not consistent with used car market.
- Is this from inattention or biased beliefs?

Perceptions and Misperceptions of Energy Costs

- Vehicle Ownership and Alternatives Survey
 - Funded by NSF and Sloan Foundation
- Nationally-representative survey collecting demographics, auto ownership, and beliefs about potential savings/costs from higher/lower fuel economy vehicles.

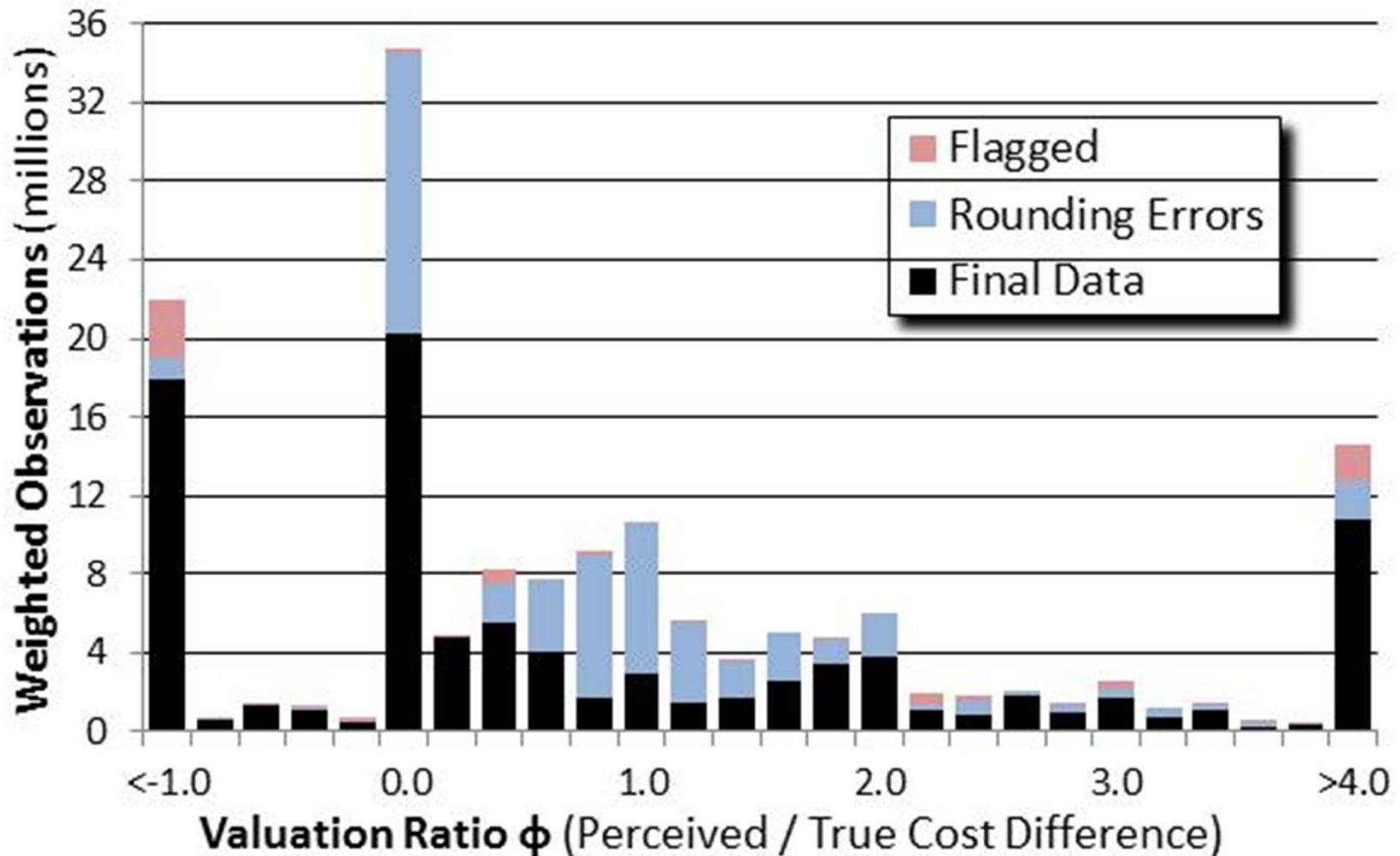
People don't think hard about gas costs

Fuel Cost Calculations at Time of Choice



People are very confused about gas costs

Valuation Ratios in Part 3



No robust evidence on systematic bias

Table 5: Systematic Overestimation or Underestimation

Ordinary Least Squares

	All	All ϕ_R	P3	P4	Low Outliers	All Outliers
	(1)	(2)	(3)	(4)	(5)	(6)
Const.	1.14 (0.06)**	1.12 (0.06)*	0.88 (0.12)	1.33 (0.06)***	1.42 (0.05)***	1.14 (0.03)***
Obs.	3290	3290	1415	1875	3076	2971

Quantile Regression at the Median

	All	All ϕ_R	P3	P4	Low Outliers	All Outliers
	(1)	(2)	(3)	(4)	(5)	(6)
Const.	0.94 (0.02)***	1.00 (4.34e-11)	0.7 (0.07)***	1.00 (0.009)	1.00 (0.01)	0.97 (0.02)*
Obs.	3290	3290	1415	1875	3076	2971

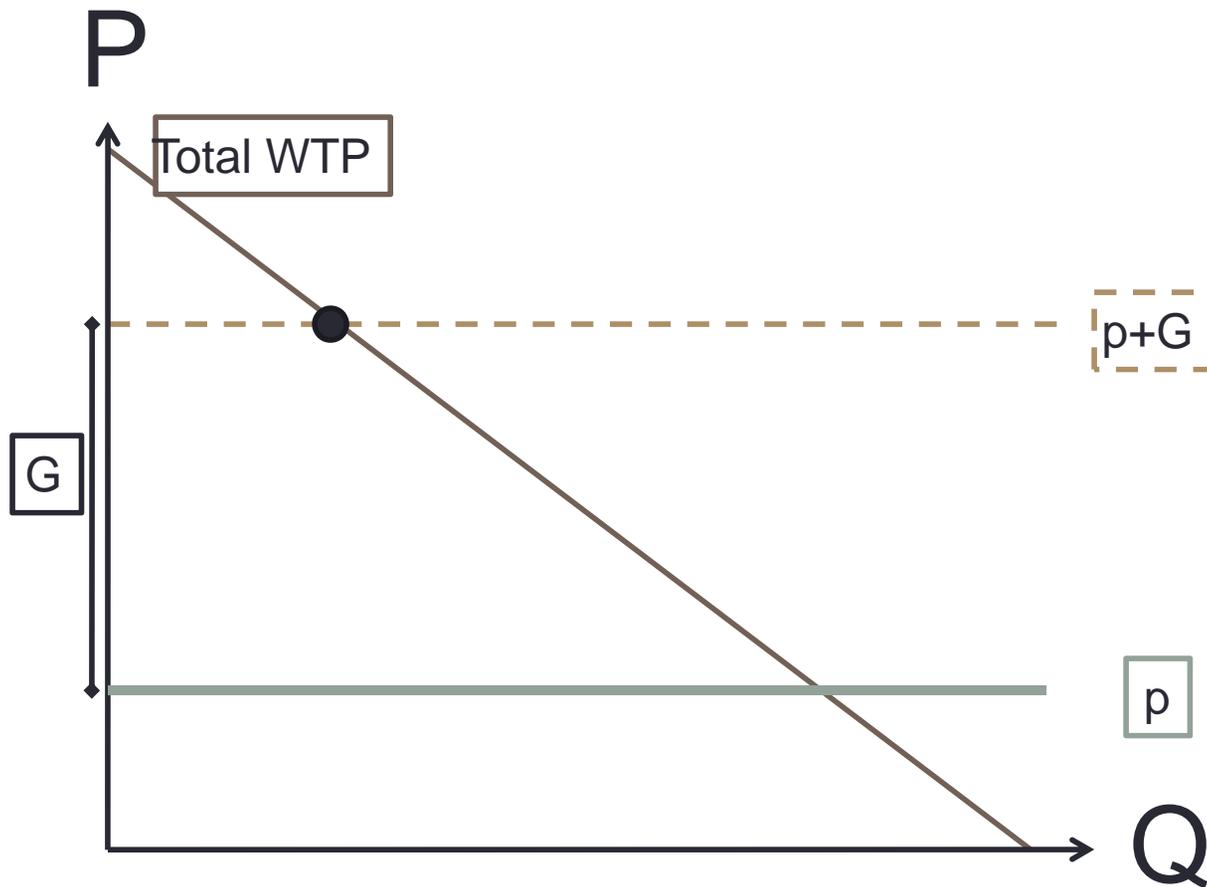
Dependent Variable: Column (2): ϕ_{Ria} . All other columns: ϕ_{ia} .

Notes: Excludes flagged observations. Weighted for national representativeness. OLS regression standard errors robust and clustered by i . *, **, ***: Statistically different from unity with 90, 95, and 99 percent confidence, respectively.

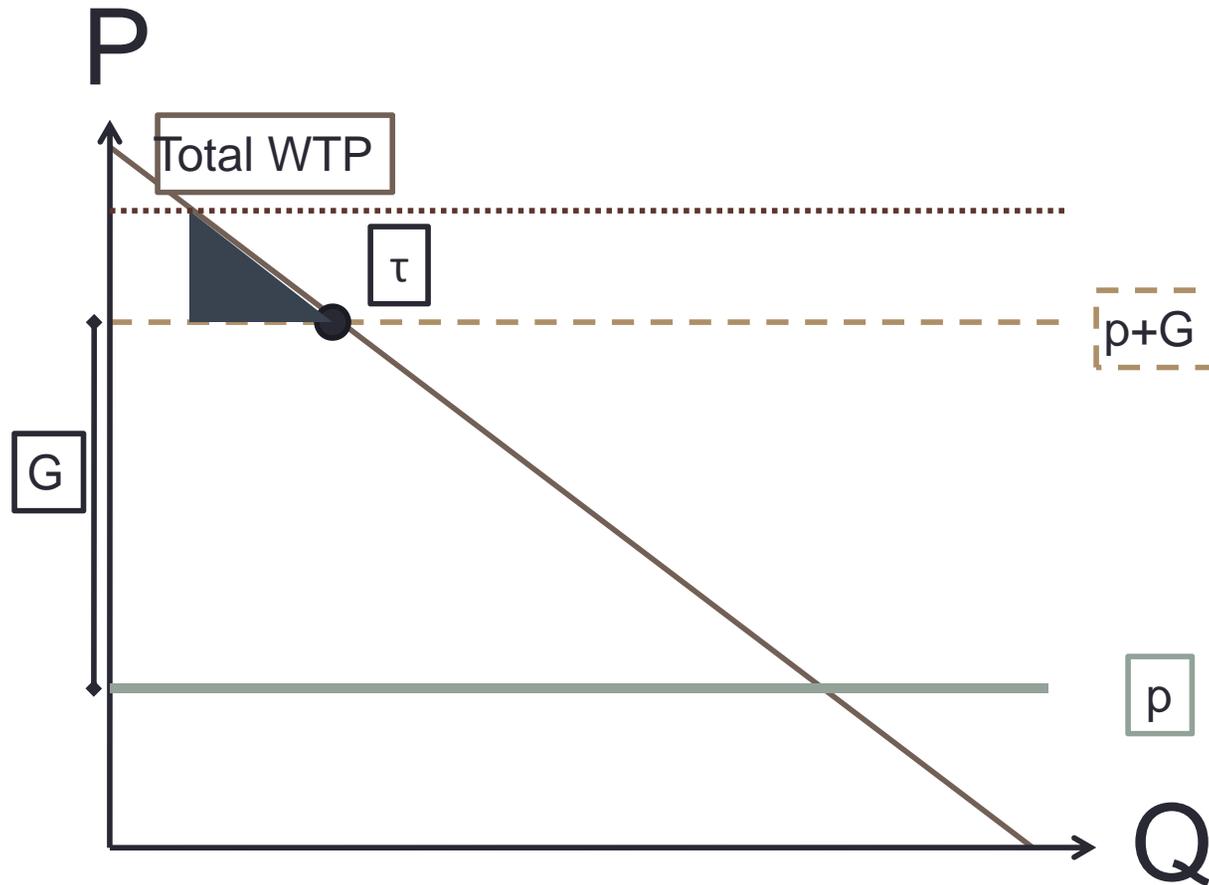
Question 2: Welfare Effects

- If we think that consumers are inattentive to gas costs, what are the welfare implications?
 - i.e., how to think rigorously about the “internality benefits” from paternalistic policies such as hybrid vehicle subsidies, CAFE standards, and gas guzzler taxes?
- Approach builds on Bernheim and Rangel (2009)
- See Allcott and Wozny (2011) or Allcott, Mullainathan, and Taubinsky (2011) for technical details.
- Stylized intuition on next few slides.

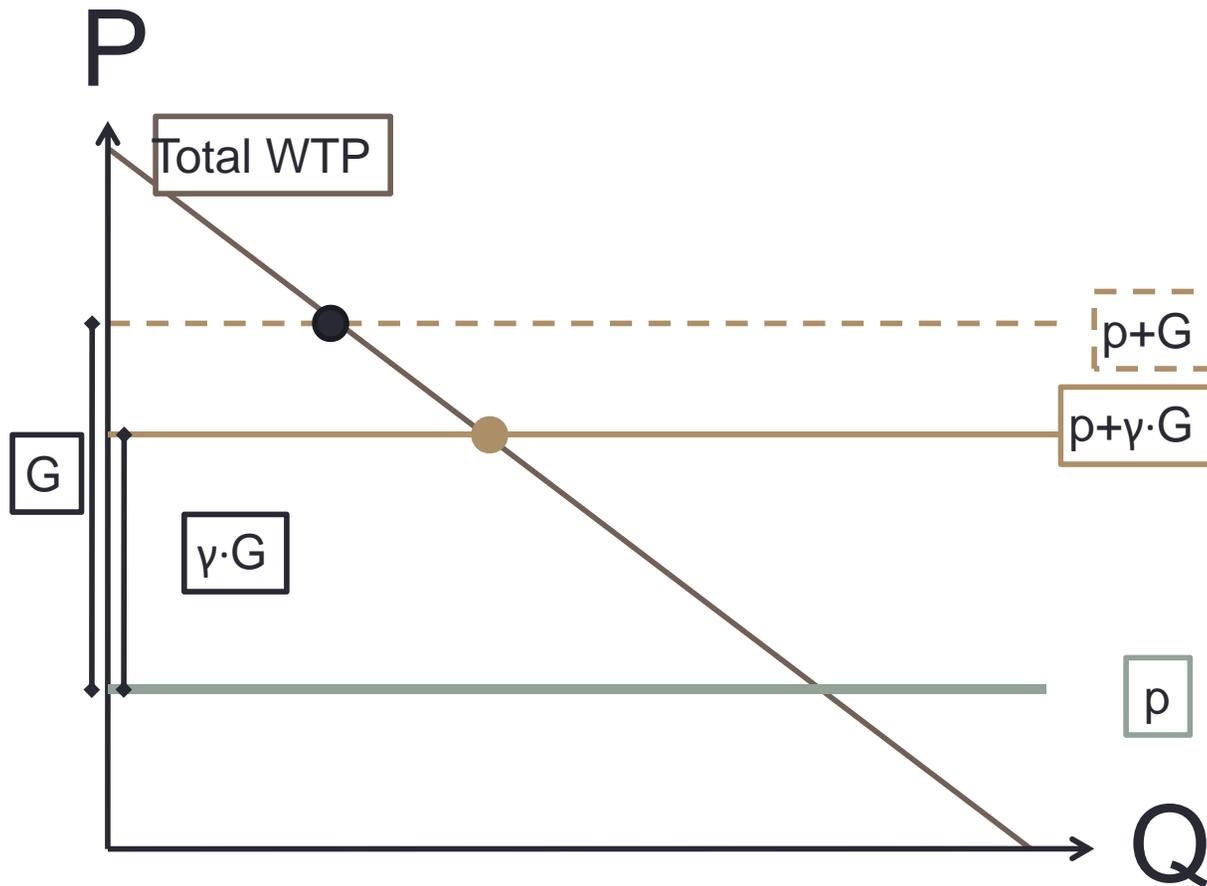
Willingness to Pay for a Gas Guzzler



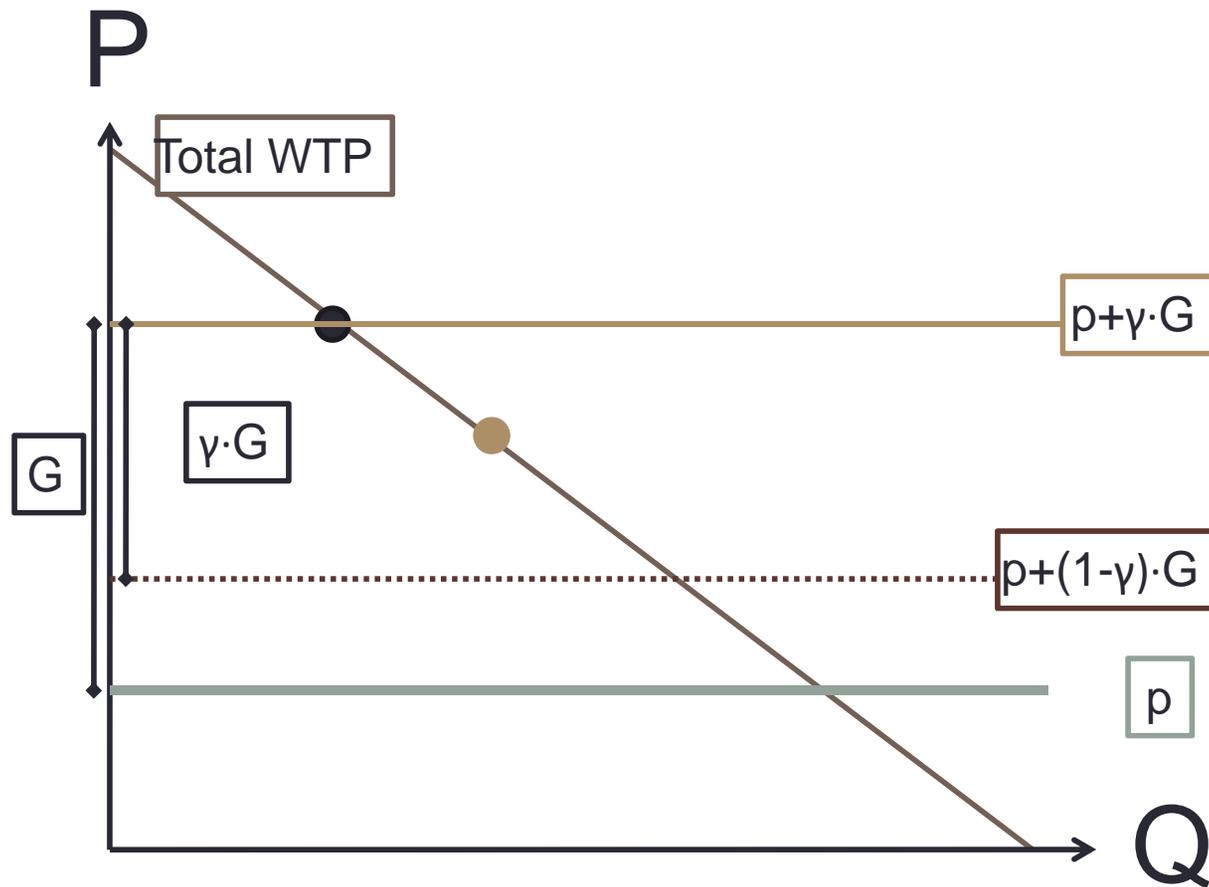
Rational Model: Effect of Tax



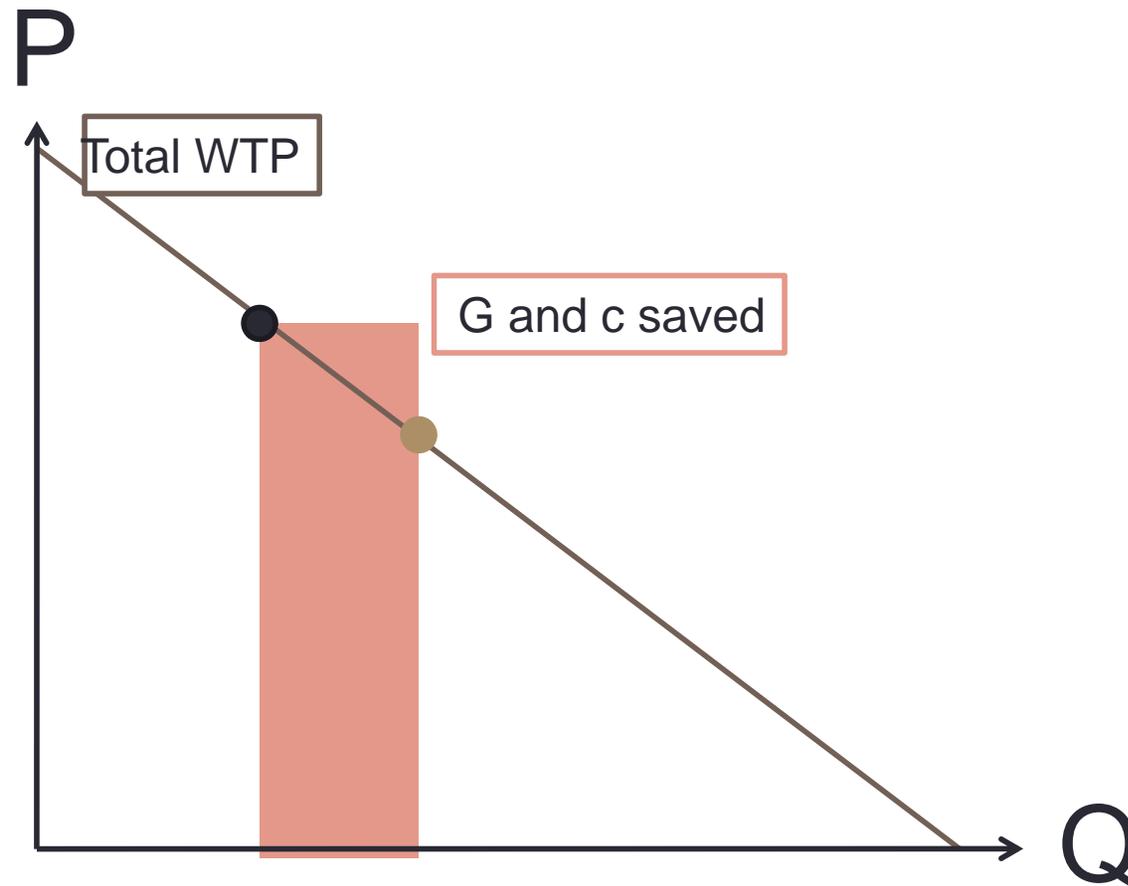
Equilibrium Under Inattention



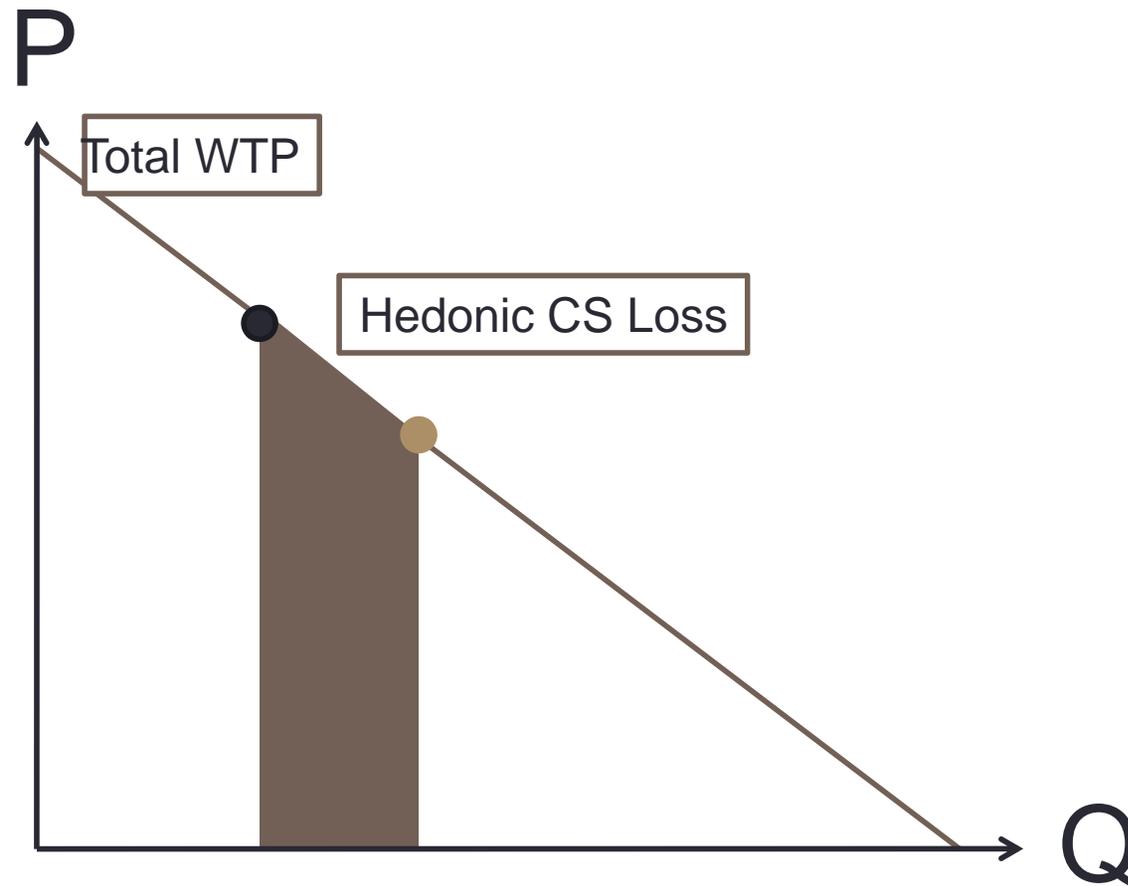
Effect of Gas Guzzler Tax Policy



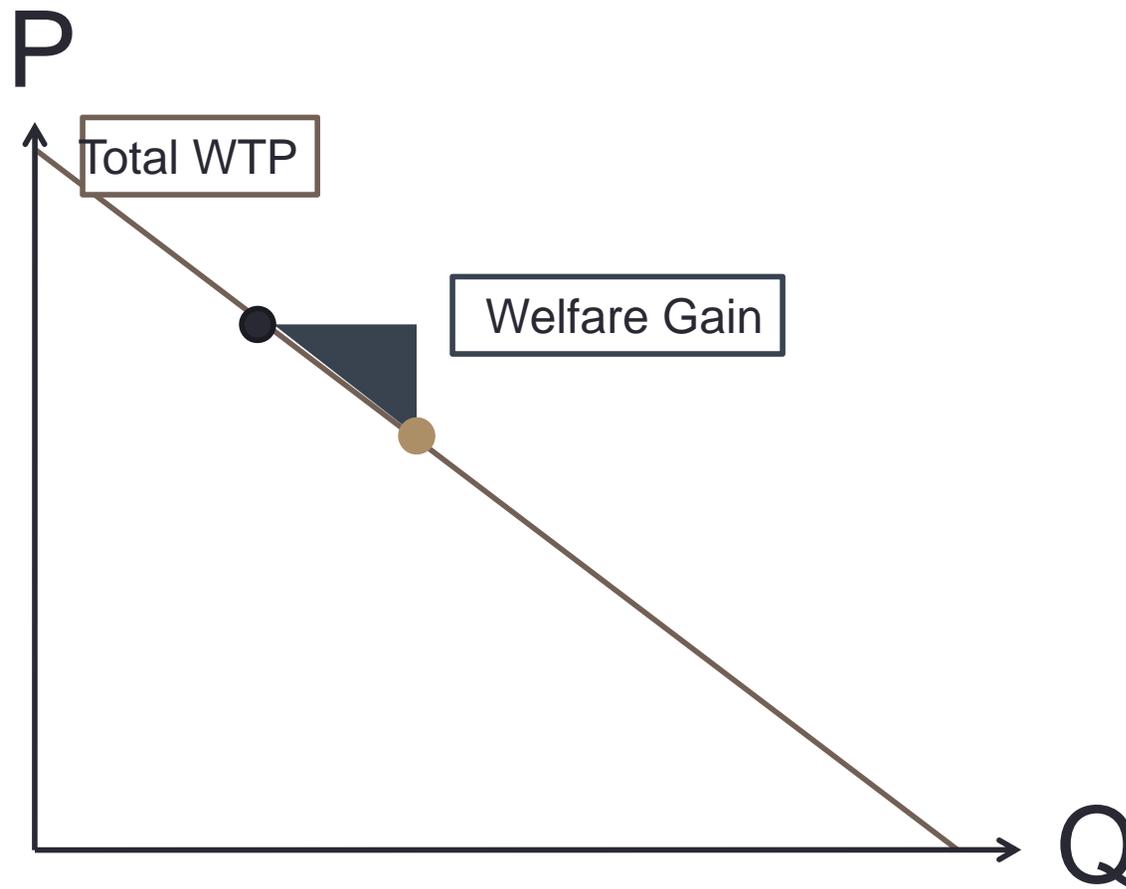
Welfare Implications



Welfare Implications



Welfare Implications



Additional Modeling Results

- CAFE standards may be more aggressive than merited.
 - Allcott/Wozny optimum: 1 MPG higher than baseline equilibrium
 - New CAFE standard: 7 MPG above previous CAFE standard!
- The model of inattention matters for what policies we advocate.
 - 72% of customers fully attentive, 28% fully inattentive?
 - All consumers 72% attentive?
- Heterogeneity in γ means that targeting is important.
 - Examples: landlords/tenants, greens/inattentives, liquidity constrained/liquid.

Additional Policy Questions

- EPA/DOE are now in the business of regulating internalities, instead of externalities. Are they equipped for this?
- Many of the investment inefficiencies (inattention, credit constraints, imperfect information, landlord-tenant) affect many many goods other than energy. Why devote so much extra attention to energy?

Unanswered Questions

- Measuring γ in different settings
 - How do consumers (and businesses) actually value energy efficiency? Cars? Factories? Universities? Toaster ovens?
- If $\gamma < 1$, understanding why.
 - Inattention, beliefs, credit constraints?
 - Policy choices depend on the specific model of inattention (Allcott, Mullainathan, and Taubinsky 2011).
- What is the role of the firm?
 - Manufacturers and retailers can nudge consumers toward or away from the energy efficient product. How well are they doing this? What are their incentives? How can we change them?

Takeaways

- It may be correct that consumers are inattentive to energy costs when they buy energy-using durables.
 - We are still cautious with the empirical results. Yet our government is betting \$128 billion on it!
- Suggests that *correctly-calibrated* standards and subsidies/taxes might improve welfare.
 - Allcott/Wozny calibration suggests that CAFE is far too aggressive
 - Ideally energy efficiency policies would be targeted toward consumers that that are misoptimizing, without distorting consumers that are not.