The Value of Environmental Status Signaling: The Case of the Toyota Prius

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Toyota Prius as Status Signal?

- Does the Toyota Prius have social status signaling value?

- What is the social status signaling value of the Toyota Prius?
- Can we econometrically estimate this signaling value?

- Everyone instantly recognizes the Prius as a hybrid
- The Prius signals that the driver cares about the environment
- All other hybrids are identical to a popular conventional engine vehicle
  - e.g., Civic hybrid, Camry hybrid
- No other hybrid is capable of signaling environmental awareness without close inspection

Status Signaling and Positional Goods

- Economists have long considered social position to be a driver of consumption (Veblen 1899)
- Competition for social rank leads to negative externalities in consumption, but equilibrium rank may not change (Frank 1985)
- Recent examples of positional goods are also green goods
  - Reusable, but expensive, bags to replace plastics
  - Solar panels on rooftops: sunny side or shady side of the house?

  - Driving a Toyota Prius
  - Green energy consumption (Alcott 2011)?

- There is little empirical work quantifying social status for environmental public goods
  - Sexton and Sexton (2011) calculate $450 - $4,200 value
- No econometric work directly estimating the signaling value of environmental public goods
  - We focus on the Toyota Prius
- Other empirical work on alternative behavioral motives in an environmental context
  - Altruism and guilt motivate energy consumption (Clark et al. 2003; Jacobsen et al. 2012)

Main Hypotheses

- The Toyota Prius has signaling value
- This signaling value is larger in areas with larger numbers of other hybrids and/or Toyota Prius hybrids

Econometric Identification and Setup

- Quasi-experimental hedonic regression
  - Directly estimate the signaling value of Toyota Prius
  - Control for observed and unobserved confounding factors

Identification of Signaling Value

- Only Prius hybrid satiates need for status
- Use hybrid indicator to control for unobservable demand drivers common to *all* hybrids
- Price premium unique to Prius must be value of status signal

Regression Model

$$\ln P_i = \beta_0 + \beta_1 D_P + \beta_2 D_H + \beta_3 X_i + \varepsilon_i$$

- $\ln P_i$ is the log of the price of the i^{th} car
- D_P is an indicator for Toyota Prius
- D_H is an indicator for hybrid, including Toyota Prius
- X_i is a set of car characteristics ; e.g., mileage, year, horsepower
- $\beta = (\beta_0, \beta_1, \beta_2, \beta_3)$ is a set of parameters to be estimated
- ε_i is a mean zero random error

Interpretation

- β_2 captures any unobservable effects common to all hybrids
  - altruism, warm-glow, guilt
- β_2 captures any remaining value unique to Toyota Prius
  - Given our controls, this identifies the status signal
  - Standard regression t-test for significance of status

Data and Regression Controls

Data Sources

- 2009 National Household Travel Survey
  - Make, model, odometer reading by household
  - Confidential zip code data for household location
- 2002-2009 WardsAuto Model Car US Specifications and Prices tables
  - Mechanical specifications for every car in survey
  - Market segment indicators (e.g., small, medium, large, etc.)
- Kelly Blue Book vehicle prices
  - Need standardized set of current vehicle values
  - Exploit variation in NHTS survey sample
  - Use zip code for detailed regional market prices

Data Sample

- Passenger, non-commercial vehicles only
- Vehicles built between 2002-2009 to match sample of hybrids
- 36,167 total vehicle observations
- 1,222 Toyota Prius hybrids
- 1,847 total hybrids (including Prius)

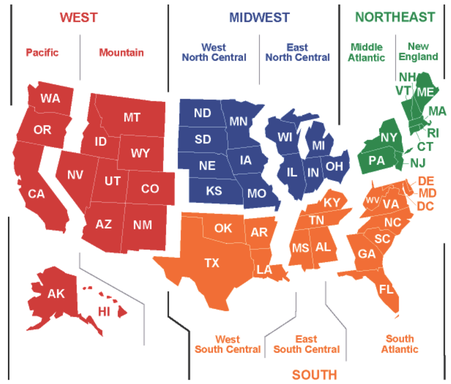
Regression Controls

- General depreciation
  - Mileage (NHTS), year built (NHTS)
- Performance measures
  - Highway MPG (KBB), horsepower (WARDs)
- Vehicle size
  - Curbweight (WARDs), cargo space (KBB)
- Safety features
  - ABS brakes (KBB), side airbags (KBB)
- Luxury features
  - Air conditioner (KBB), alloy wheels (KBB), CD player (KBB), cruise control (KBB)
- Indicators for make, model, and market segment

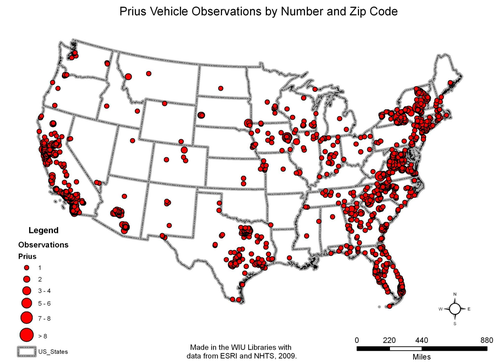
Hedonic Estimation of Signaling Value

Hedonic Market Definitions

- Census divisions – relatively large markets



- Metropolitan Statistical Areas (MSA's)
  - Smaller markets consistent with consumer behavior
  - Focus on clusters of hybrids (see location of Prius hybrids)
  - Heterogeneity in Prius premium across cities



Census Division Regressions

	Implied Marginal Values ($)	
Census Division	Prius	Hybrid
Pacific	2229.12***	544.06***
Mountain	2497.70***	-157.02
West North Central	4468.28***	-6.49
East North Central	2681.21***	782.89**
West South Central	2370.03***	156.14
East South Central	2090.66***	1061.83***
South Atlantic	2134.12***	308.91**
Mid Atlantic	2419.57***	238.37
New England	2023.69***	327.69

MSA Regressions – 5 Major MSA Areas

	Implied Marginal Values ($)	
MSA Area	Prius	Hybrid
San Francisco	1850.14***	304.95
San Diego	2905.47***	901.02***
New York City	1307.32***	619.40
Washington D. C.	1224.55***	905.10**
Upstate New York	4189.53***	427.49

Remarks and Discussion

- Significance of Prius premium
  - Status signaling value of Prius is robustly significant across regions and cities
  - Heterogeneity in signaling value: $1,224 - $4,468
- Hybrid effect is not always significant
  - Non-status behavioral hypotheses may not be very strong
- Hybrid effect is substantially lower than Prius premium
  - Signaling effect dominates other behavioral hypotheses
  - Empirical evidence of relative magnitudes of behavioral motives
- Results provide evidence of social status motivation of private provision of environmental public goods
- Direction for future theoretical research on private provision of environmental public goods
  - Important for public goods that are visible

Future Directions

- Consider all possible MSA regions
- Explore significance/magnitude of Prius effect across MSA's
  - Higher premium with higher Prius density?

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