# Supplemental Appendix to:

# Hybrid Vehicles and Household Driving Behavior: Implications for Miles Traveled and Gasoline Consumption

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**Abstract**

This appendix contains additional descriptive statistics, reduced form regression results for hybrid adoption and annual miles traveled regression models, and additional post-match checks that are discussed but not reported in the manuscript.

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## 1. Data and Descriptive Statistics

The complete details regarding the 2009 NHTS data can be found on the NHTS survey website. This section describes several important points that are relevant for our analysis.

### 1.1 Annual Miles Traveled

The measure of household annual miles traveled comes from the variable BESTMILE in the NHTS survey. For complete details, see Oak Ridge National Laboratory (2011).

As stated in the manuscript, BESTMILE is the NHTS's best estimate of household vehicle miles traveled and is based on self-reported annual miles traveled, the odometer reading of each vehicle, and information on the primary driver. When all of these three sources are available, all are used jointly to construct the estimate of annual miles traveled; 72.4 percent of the vehicles in the NHTS survey fall into this category. When some information is missing, only the existing information is used; and when no information is available, driving information on the travel day is used. After estimation, the annual miles estimate is validated via comparison to the odometer reading and self-reported annual miles traveled. If the difference surpasses certain criteria, the annual miles estimate is identified as an outlier; in our analysis, we drop all households for which the BESTMILE estimate is classified as an outlier.

### 1.2 Additional Descriptive/Balancing Variables

In addition to the variables described in the manuscript, several auxiliary variables may also correlate with the hybrid adoption decision and driving decision. We do not include these variables in our matching models because

(i) these variables are redundant in our set of matching covariates; and/or
(ii) these variables do not improve the balance of our matched datasets if included.

However, assessing balance on these variables is an important metric of the quality of our match, so we include them in the descriptive statistical analysis and the pre- and post-match balancing assessments.

**Additional Household Level Variables** The first set of additional variables are household level demographic variables. These include a categorical indicator for the life cycle stage of the household, which indicates whether the household has one or two heads, children, and whether or not the head(s) are retired.[2] This set of variables also includes the number of drivers and workers in each household, whether or not the household self-reports as being Hispanic (zero otherwise), and the race of each household (which is categorical).[3] These variables are important correlates of both the hybrid adoption decision and miles traveled, but they are redundant (in our sample) given our controls for income, education,

[2] Specifically, the categories with values 1 to 10 are one adult, no children; 2+ adults, no children; one adult, youngest child 0-5; 2+ adults, youngest child 0-5; one adult, youngest child 6-15; 2+ adults, youngest child 6-15; one adult, youngest child 16-21; 2+ adults, youngest child 16-21; one adult, retired, no children; 2+ adults, retired, no children.

[3] The categories with values from 1 to 8 indicate whether the household members are white, African American, Asian, American Indian or Alaskan Native, Native Hawaiian or Other Pacific, Multiracial, Hispanic/Mexican, or other.

household size, number of vehicles, the average age of drivers, and working commute distance.

The second set of additional household level variables are categorical variables that describe the broad geographic location in which the household resides. These include *MSA Category* that measures the size of the metropolitan statistical area of each household; *Rail* that is a binary variable that measures whether or not the MSA area has rail transportation services available; and *Urban/Rural* that is a binary indicator that differentiates urban from rural areas.[4] We exclude these variables because they are redundant given our requirement that matched households must reside within the same CBSA or zip code.

**Gasoline Price** We obtained quarterly data on the price of regular grade gasoline at the city level from 2000 to 2009 from the Council for Community and Economic Research. We match households via the vehicle purchase year and geographic location to control the effect of gasoline prices on hybrid adoption and driving behavior. The majority of the data is at the city level; when city level data is not available, we use CBSA level data; when the data at both of these two levels is not available, state level price data is used. We use the gasoline price both at the time in which the hybrid was purchased and in 2008 which is the time the NHTS survey was taken to control for the effects of gasoline on both hybrid adoption and household driving behavior.

**Government Policy Incentives** Incentives from the federal government and state government are also important factors influencing household hybrid adoption (Sallee 2011). We obtain detailed data on these policy incentives from the Internal Revenue Service, the Alternative Fuels Data Center of the United States Department of Energy, official state statute documentation, and previous economic research (Diamond 2009, Gallagher and Muehlegger 2011, Sallee 2011).

Before 2006, the federal government provided a $2,000 federal tax deduction for all hybrid purchases. The exact benefit for each household depended on the real income tax rate for the household, which we cannot observe. We assume the same tax rate, 25 percent, for all households; 25 percent is close to that calculated by Beresteanu and Li (2011) using TAXSIM tax software. Since January 1, 2006, the tax deduction policy was replaced by a tax credit policy. The specific amount of credit that a hybrid model receives is based on its fuel efficiency compared to equivalent gasoline vehicles. The amount of the tax credit across models varies between $450 and $3,150, and is phased out gradually after the manufacturer sells a total of 60,000 hybrids. Federal tax credit incentives for all hybrids from Toyota phased out in 2007, and federal tax credit incentives for hybrid models from Honda phased out at the end of 2008. To obtain a uniform measure of the tax credit across households, we use the weighted mean of tax credits across all hybrids in our dataset at each point in time. The weight for each hybrid model is determined by the proportion of that model across all hybrid models in the data, which is a proxy for the market share for

[4] Specifically, MSA category takes values 1 if the MSA in which the household lives has a population of 1 million or more, and has a rail system; 2 if the MSA has a population of 1 million or more, but does not have a rail system; 3 if the MSA has a population of less than 1 million; 4 if the household is not in an MSA. The MSA population variable takes a value of 1 if the household lives in an MSA with fewer than 250,000; 2 for an MSA with a population between 250,000-499,999; 3 for an MSA with 500,000-999,999; 4 for an MSA of 1,000,000-2,999,999; 5 for an MSA of 3 million more; and 6 if the household is not in an MSA.

each hybrid.

State hybrid incentives include income tax credits, sales tax exemptions, tax rebates, and HOV lane access. Detailed information on federal and state incentives, including the specific implementation period, amount, and data sources, are provided in Tables A1-A3. Table A1 lists the size of the federal hybrid vehicle tax credit for each make/model that are still ongoing at the time of the NHTS survey. These credits were available after January 1, 2006. Table A2 provides a vehicle/time specific summary of federal hybrid tax credits that had been phased out at the time of the survey given the volume of hybrid sales by the manufacturer. Table A3 details different state level incentives for hybrid vehicle adoption by type of incentive.

### 1.3 Hybrid Vehicles Included in the Analysis

Table A4 lists all of the hybrid vehicles included in our analysis by make and model. The table reports both the total number of each hybrid, as well as the percentage of observations in the sample that correspond to each hybrid model.

**Table A1**: Ongoing Federal Tax Credits for Hybrid Vehicles (after 1/1/2006)

| Make | Model | Credit Amount |
|---|---|---|
| Cadillac | Escalade | $2,000 |
| Chevrolet | Malibu | $1,300 |
| Chevrolet | Tahoe | $2,200 |
| Chevrolet | Silverado | $450 |
| Chrysler | Aspen | $2,200 |
| Dodge | Durango | $2,200 |
| Ford | Escape | $2,475 |
| GMC | Yukon | $2,200 |
| GMC | Sierra | $450 |
| Mazda | Tribute | $2,475 |
| Mercury | Mariner | $2,475 |
| Nissan | Altima | $2,350 |
| Saturn | Aura | $1,300 |
| Saturn | Vue Green Line | $1,550 |

The data in this table come from two sources: (1) IRS http://www.irs.gov/uac/AlternativeMotor-Vehicle-Credit-1 and (2) http://www.cars.com/go/advice/Story.jsp?section=buy and subject=tax and story=taxCredit. Further, when there is a difference in the credit amount across different model years for a certain hybrid model, we use the credit amount for the most recent model year before 2009. When there is a difference in the credit amount across different types of hybrids within a certain model, we use the mean of the credit amounts.

**Table A2**: Phased Out Federal Tax Credits for Hybrid Vehicles (after 1/1/2006)

| Model | Purchase Date | Credit Amount |
|---|---|---|
| Toyota Prius | 1/1/2006 - 9/30/2006 | $3,150 |
| | 10/1/2006 - 3/31/2007 | $1,575 |
| | 4/1/2007 - 9/30/2007 | $787.50 |
| | 10/1/2007 - | $0 |
| Toyota Camry | 1/1/2006 - 9/30/2006 | $2,600 |
| | 10/1/2006 - 3/31/2007 | $1,300 |
| | 4/1/2007 - 9/30/2007 | $650 |
| | 10/1/2007 - | $0 |
| Toyota Highlander | 1/1/2006 - 9/30/2006 | $2,600 |
| | 10/1/2006 - 3/31/2007 | $1,300 |
| | 4/1/2007 - 9/30/2007 | $650 |
| | 10/1/2007 - | $0 |
| Lexus GS 450h | 1/1/2006 - 9/30/2006 | $1,550 |
| | 10/1/2006 - 3/31/2007 | $775 |
| | 4/1/2007 - 9/30/2007 | $387.50 |
| | 10/1/2007 - | $0 |
| Lexus RX 400h | 1/1/2006 - 9/30/2006 | $2,200 |
| | 10/1/2006 - 3/31/2007 | $1,100 |
| | 4/1/2007 - 9/30/2007 | $550 |
| | 10/1/2007 - | $0 |
| Lexus LS 600h | 1/1/2006 - 9/30/2006 | $1,800 |
| | 10/1/2006 - 3/31/2007 | $900 |
| | 4/1/2007 - 9/30/2007 | $450 |
| | 10/1/2007 - | $0 |
| Honda Civic | 1/1/2006 - 1/1/2008 | $2,100 |
| | 1/1/2008 - 6/30/2008 | $1,050 |
| | 7/1/2008 - 12/31/2008 | $525 |
| | 1/1/2009 - | $0 |
| Honda Accord | 1/1/2006 - 1/1/2008 | $1,300 |
| | 1/1/2008 - 6/30/2008 | $650 |
| | 7/1/2008 - 12/31/2008 | $325 |
| | 1/1/2009 - | $0 |
| Honda Insight | 1/1/2006 - 1/1/2008 | $1,450 |
| | 1/1/2008 - 6/30/2008 | $725 |
| | 7/1/2008 - 12/31/2008 | $362.50 |
| | 1/1/2009 - | $0 |

**Table A3**: Summary of State Level Incentives for Hybrid Vehicles

| State | Amount | Start Date | End Date |
|---|---|---|---|
| *Income Tax Incentives* | | | |
| Colorado | $6542* | 7/1/2000 | 12/31/2010 |
| Louisiana | $500* | 1/1/1991* | 7/9/2009 |
| New York | $2,000 | 1/1/2001* | 12/31/2004 |
| Oregon | $1,500 | 1/1/1998* | 12/31/2009 |
| South Carolina | $630* | 6/1/2006 | 12/31/2009 |
| Utah | $1720* | 2001* | 12/31/2005* |
| West Virginia | $3750* | 7/1/1997 | 6/30/2006 |
| *Sales Tax Incentives* | | | |
| Connecticut | $1500* | 10/1/2004 | 10/1/2008 |
| Washington D.C. | $3294* | 4/15/2005* | Not yet expired |
| Maine | $625* | 1/1/1997 | 12/31/2005 |
| Maryland | $1,000 | 7/1/2000 | 7/1/2004 |
| Maryland | $1,500 | 7/1/2004 | 5/20/2010 |
| New Mexico | $750* | 7/1/2004 | 6/30/2009 |
| New York | $240* | 1/1/2000 | 5/28/2005 |
| Washington | $2,015 | 1/1/2009 | 7/31/2009 |
| Washington | $73 | 8/1/2009 | 12/31/2010 |
| *HOV Lane Access* | | | |
| California | | 8/10/2005* | 6/30/2007 |
| Colorado | | 3/1/2008 | Not yet expired |
| Florida | | 2003 | 9/30/2017 |
| New York | | 3/1/2006 | 9/30/2017 |
| Utah | | 9/1/2006* | 12/31/2010 |
| Virginia | | 6/30/2006* | 7/1/2011 |
| *Rebate Incentives* | | | |
| Illinois | $1,000 | 7/15/2007 | 10/1/2008 |
| Pennsylvania | $500 | 11/29/2004 | 3/6/2010 |
| *Testing Exemptions* | | | |
| Idaho | | 2008 | Not yet expired |
| Maryland | | 2005 | 9/30/2012 |
| Nevada | | 5/31/2007 | Not yet expired |
| *Personal Property Tax Incentive* | | | |
| Michigan | $32 | 7/26/2002 | 12/31/2012 |

The $*$ indicates that the value comes from previous studies.

**Table A4**: Summary of Makes and Models for Hybrid Vehicles

| Make | Model | Number | Percent |
|---|---|---|---|
| Cadillac | Escalade | 1 | 0.1 |
| Chevrolet | Tahoe | 19 | 1.4 |
| Chevrolet | Silverado | 2 | 0.1 |
| Chrysler | Aspen | 3 | 0.2 |
| Ford | Escape | 61 | 4.5 |
| GMC | Yukon | 10 | 0.7 |
| Honda | Civic | 178 | 13.1 |
| Honda | Accord | 42 | 3.1 |
| Lexus | LS 600hl | 3 | 0.2 |
| Lexus | GS 450h | 9 | 0.7 |
| Lexus | RX 400h | 26 | 1.9 |
| Mazda | Tribute | 1 | 0.1 |
| Mercury | Mariner | 14 | 1.0 |
| Nissan | Altima | 17 | 1.3 |
| Saturn | Vue Green Line | 9 | 0.7 |
| Toyota | Camry | 141 | 10.4 |
| Toyota | Prius | 726 | 53.5 |
| Toyota | Highlander | 94 | 6.9 |
| **Total** | | **1356** | **100** |

## 2. Reduced Form Empirical Evidence

Here, we present a brief reduced form analysis of hybrid adoption and annual miles traveled. Understanding these patterns is important for assessing the ability of our preferred matching approach to eliminate any covariate imbalance between hybrid and non-hybrid households, relative to a basic parametric regression approach. These results are also useful in establishing

(i) why we focus on the $ATT$ and not the $ATE$; and
(ii) why we do not pursue an instrumental variables strategy using the federal tax incentives as instruments.

### 2.1 Factors that Correlate with Hybrid Ownership

We first explore factors that correlate with hybrid ownership via probit regression of a hybrid ownership indicator on household demographics, characteristics of vehicles in each household, the availability of government (federal and state) incentives, local (city-level) gasoline prices, market penetration rate of hybrids, geographic controls, and year fixed effects. We report these results in Table A5.

We find that many common stereotypes hold in our data: households that have relatively high income, have a graduate education, are frequent internet users, and have fewer family members tend to adopt a hybrid. We find that households that have higher MPG ratings on other vehicles in the household are also more likely to own a hybrid, which suggests consistency in fuel efficiency and environmental preferences within the household. The market penetration rate for hybrids is positively correlated with hybrid adoption, as is MSA city size. Even though there appears to be a quadratic relationship between gasoline price and hybrid adoption, the majority of the data in our sample lie on the positive relationship side. Finally, time dummies reveal an increasing trend in hybrid adoption over time.

Table A5 shows that federal tax incentives are positively correlated with hybrid ownership. However, other models we explore indicate that this significance is not robust. For example, the significance disappears if we control for state fixed effects. We find that state level incentives are not significant.

In the last column in Table A5, we restrict the sample to hybrid-owning households, and investigate differences between Prius-owning households and non-Prius hybrid households. The table reveals that there are few significant differences between Prius households and non-Prius hybrid households. We see that households in the highest income category are less likely to buy a Prius, but households being frequent Internet users and/or with a higher average MPG rating on other vehicles are more likely to buy a Prius. We suspect that the income effect comes from the presence of luxury hybrids in the dataset: the highest income hybrid consumers are more likely to buy a Toyota Camry hybrid than a Prius. Households with higher average MPG rating are more likely to buy a Prius and it may indicate that Prius households have higher preference for environmental preservation so they are willing to pay for the social signal value of the Prius.

These probit regressions also provide critical insight into the types of causal effects that can be identified with respect to hybrid vehicles and hybrid drivers. Our hybrid probit estimates have a range of support being (0.000, 0.507). Across many other probit models we estimated – that both include and exclude the federal incentive variable as a potential

instrumental variable – we do not obtain estimates of the propensity score for the hybrid model that have a maximum support that exceeds about 0.55. Given the theoretical econometric conditions (e.g., Heckman and Vytlacil 2005), these estimates indicate that identification of an $ATE$ parameter is not feasible, at least given our NHTS sample.

**Table A5**: Probit Estimates of the Propensity Score of Hybrid/Prius Ownership

| | Hybrid Adoption | Prius Adoption |
|---|---|---|
| Constant | -5.405*** (0.506) | -1.657 (1.264) |
| Middle Income | 0.068 (0.043) | -0.058 (0.133) |
| High Income | 0.288*** (0.045) | -0.238* (0.137) |
| High School Degree | -0.218 (0.209) | 0.330 (0.780) |
| Associate's Degree | 0.012 (0.204) | 0.541 (0.776) |
| Bachelor's Degree | 0.127 (0.204) | 0.631 (0.774) |
| Graduate Degree | 0.370* (0.204) | 0.845 (0.773) |
| No. of Vehicles | -0.005 (0.022) | 0.100* (0.060) |
| Household Size | -0.067*** (0.016) | 0.015 (0.047) |
| Average Age | 0.021*** (0.008) | -0.021 (0.022) |
| Average Age Squared | -0.0002** | 0.0003 (0.0002) |
| Share of Female Drivers | -0.077 (0.063) | 0.149 (0.174) |
| Internet Usage | 0.246*** (0.053) | 0.333* (0.170) |
| MPG of Other Vehicles | 0.030*** (0.003) | 0.026*** (0.006) |
| Commute Distance | 0.0002 (0.001) | -0.0001 (0.002) |
| Federal Incentive | 0.094** (0.046) | -0.063 (0.127) |
| State Incentive | -0.015 (0.033) | 0.076 (0.079) |
| HOV Lane Access | -0.050 (0.032) | 0.032 (0.086) |
| Gas Price | 0.570** (0.224) | 0.565 (0.610) |
| Gas Price Squared | -0.102*** (0.039) | -0.074 (0.104) |
| Market Penetration Rate of Hybrids | 15.569*** | 6.657* (3.823) |
| Urban | -0.011 (0.033) | -0.156* (0.093) |
| Mid-Size MSA | -0.083** (0.037) | -0.111 (0.100) |
| Small MSA | -0.076* (0.040) | -0.082 (0.111) |
| Not in MSA | -0.143*** (0.051) | 0.094 (0.141) |
| 2002 Indicator | 0.903*** (0.323) | |
| 2003 Indicator | 0.919*** (0.318) | -0.622* (0.348) |
| 2004 Indicator | 1.041*** (0.316) | -0.106 (0.332) |
| 2005 Indicator | 1.097*** (0.319) | -0.426 (0.360) |
| 2006 Indicator | 0.935*** (0.343) | -0.749 (0.506) |
| 2007 Indicator | 1.092*** (0.325) | -0.844** (0.401) |
| 2008 Indicator | 1.115*** (0.326) | -0.919** (0.408) |
| 2009 Indicator | 0.947** (0.377) | −6.190 (87.650) |
| Observations | 36,780 | 1,285 |
| Log Likelihood | -4,961.256 | -827.811 |
| Akaike Inf. Crit. | 9,988.512 | 1,719.622 |
| Range of support | [0.000,0.507] | [0.000,0.954] |

Middle income is defined as income between $50,000 and $100,000 per year, and high income is defined as annual household income above $100,000. The range of support at the bottom of the table indicates the range of support of the estimated propensity score for each model. Statistical significance at the 10, 5, and 1 percent level is denoted with ∗, ∗∗, and ∗∗∗, respectively. In the Prius adoption model, both 2001 and 2002 year indicators are used as the base category because there are too few households in the data that purchased a Prius in 2001.

With the dominantly large sample of non-hybrid households, estimates of the propensity score are arbitrarily close to zero, which indicates that the *ATT* may be identified. If a stereotypical hybrid household is one with certain characteristics, it is possible to find plenty of non-hybrid households who match the same characteristics. Hence, from these insights, we choose to focus on the *ATT*; this parameter is more likely to be identified by observational data, and also allows for informed policy assessment via a means of understanding whether existing hybrid owners drive differently from the counterfactual.

### 2.2 Factors that Correlate with Annual Miles Traveled

In Table A6 we report reduced form least squares estimates from the regression of annual miles traveled on the hybrid ownership indicator and Prius ownership indicator. We find that hybrid ownership correlates positively and statistically significantly with annual miles traveled. The point estimate implies that hybrid-owning households, all else constant, drive nearly 915 miles more per year compared to non-hybrid households. The last column in Table A6 reveals that there is not a significant difference in annual miles traveled between Prius households and non-Prius hybrid households.

Many other control variables in the hybrid adoption model are significant, and take the expected sign. We see that an increase in income correlates with an increase in annual miles traveled, and that households around 30 years old drive more than other households. Larger households, households with more vehicles, or households with longer commute distance, drive more. Other point estimates indicate that households in the largest MSAs (the base group) or live in urban area average fewer driving miles per year. More interestingly, households with higher MPG ratings on other vehicles drive fewer miles per year, and households with higher Internet use frequency drive more per year.

We do not find much significant difference between Prius households and non-Prius hybrid households in terms of annual miles traveled. In this model, we find that annual miles traveled is increasing in income, the number of vehicles, household size, and the length of commute. The residential location of households also affects travel distance, with greater driving in less urbanized areas.

The reduced form least squares estimates provide basic information on variables related to hybrid (Prius) adoption and annual miles traveled of households. However, our primary analysis does not rely on these regressions since the reduced forms are limited by the assumed functional form and are not able to flexibly incorporate all critical influencing factors (e.g., local social pressure, certain characteristics of vehicles) into the model.

**Table A6**: OLS Estimates of Annual Miles Traveled for Hybrid/Prius Adoption

| | Hybrid | Prius |
|---|---|---|
| Constant | 1,013.50 (6,218.80) | 3,559.29 (35,497.82) |
| Hybrid/Prius Adoption | 914.28*** (341.55) | −789.55 (664.56) |
| Middle Income | 1,284.93*** (168.94) | 541.89 (1,167.32) |
| High Income | 2,897.99*** (196.02) | 2,588.98** (1,194.65) |
| High School Degree | −98.15 (630.64) | 6,235.85 (5,910.54) |
| Associate's Degree | 932.56 (626.03) | 9,150.67 (5,717.48) |
| Bachelor's Degree | 720.07 (630.34) | 8,758.71 (5,704.44) |
| Graduate Degree | 796.81 (633.46) | 9,221.77 (5,700.51) |
| No. of Vehicles | 7,305.19*** (101.13) | 8,287.00*** (524.90) |
| Household Size | 1,304.51*** (70.25) | 820.17** (408.96) |
| Average Age | 185.28*** (33.32) | 180.19 (193.31) |
| Average Age Squared | −3.12*** (0.31) | −2.92 (1.78) |
| Share of Female Drivers | 42.50 (273.07) | −308.12 (1,527.64) |
| Internet Usage | 954.46*** (188.98) | −1,117.97 (1,480.14) |
| MPG of Other Vehicles | −30.79** (14.02) | −7.56 (48.96) |
| Commute Distance | 164.16*** (3.94) | 191.04*** (19.04) |
| Gas Price | −1,054.90 (1,588.37) | −7,815.34 (9,022.92) |
| Urban | −1,826.30*** (148.24) | −1,558.44* (817.93) |
| Mid-Size MSA | 608.97*** (224.62) | 781.47 (997.04) |
| Small MSA | 1,155.14*** (224.77) | 434.21 (1,077.96) |
| Not in MSA | 2,742.35*** (251.10) | 3,216.99** (1,307.83) |
| Observations | 36,780 | 1,285 |
| State Fixed Effects | Yes | Yes |
| $R^2$ | 0.33 | 0.43 |
| Adjusted $R^2$ | 0.34 | 0.40 |
| Residual Std. Error | 11,846.46 | 11,183.95 |
| F Statistic | 265.99*** | 14.48*** |

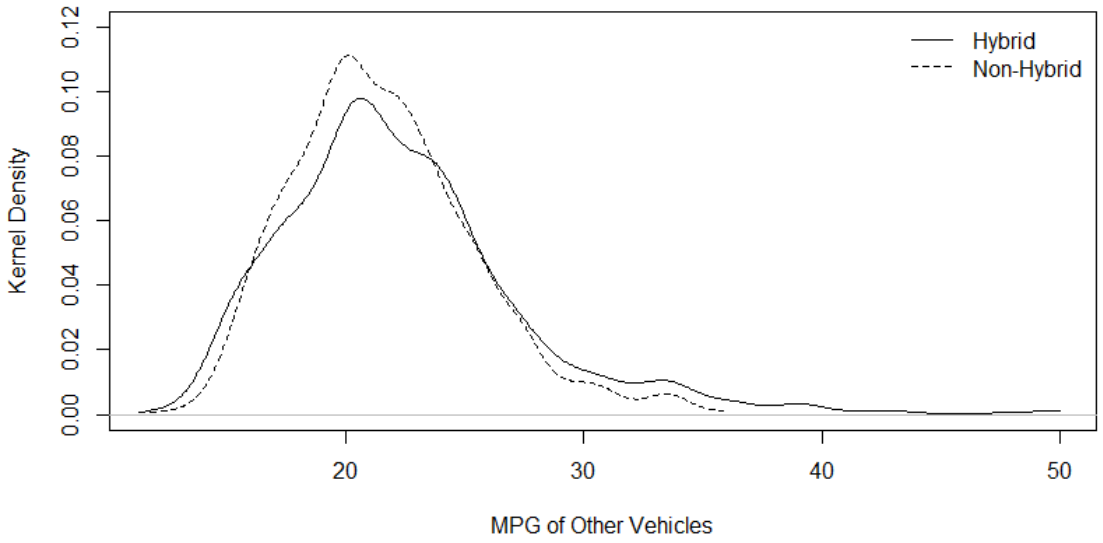
Middle income is defined as income between $50,000 and $100,000 per year, and high income is defined as annual household income above $100,000. Statistical significance at the 10, 5, and 1 percent level is denoted with ∗, ∗∗, and ∗∗∗, respectively.

# 3 Additional Post-Match Checks

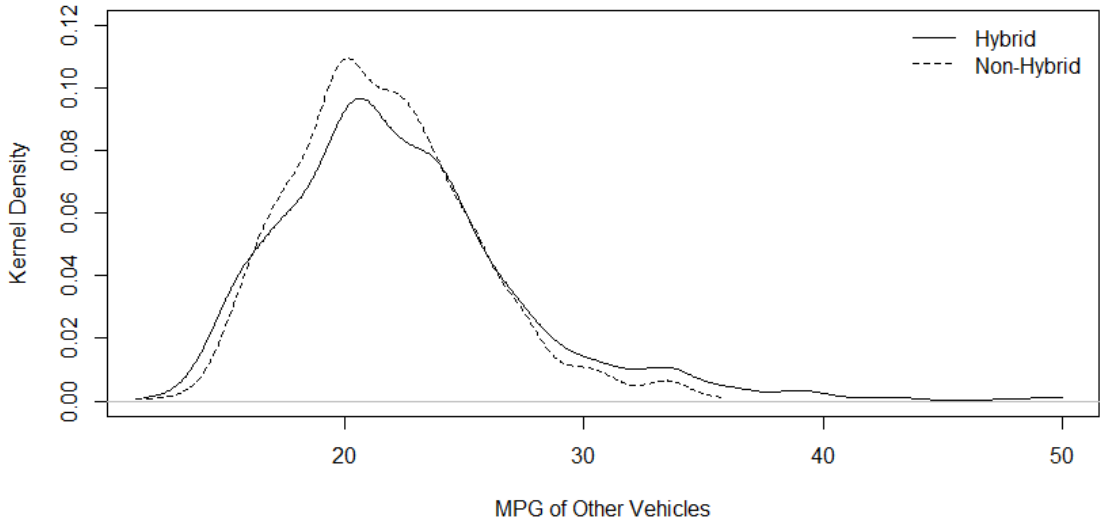
## 3.1 Further Investigation into the Post-Match Balance for "MPG of Other Vehicles"

To further explore any possible post-match distributional differences in the MPG of Other Vehicles variable in the CBSA hybrid model matching on vehicle type (Appendix B, Table B2), we examine the full distributions of this variable across the hybrid and non-hybrid (matched) households. We undertake this additional exploration given the importance of this covariate in our analysis for accounting for unobservable household preferences for lower travel cost and/or environmental preservation.

Figure A1 shows the kernel densities of the hybrid (treated) and non-hybrid (control) matched samples for the MPG of Other Vehicles variable. We can see from the figure that, despite the normalized difference of 0.176 and 0.167 in Appendix B, Table B2, there is not much difference in the overall distribution across samples. Hence, there is not substantive evidence that this covariate remains out of balance post-match to the extent that we believe there exists bias in our estimates.




(a) Kernel densities corresponding to Model 1 in Table A9




(b) Kernel densities corresponding to Model 2 in Table A9.

**Figure A1**: Estimated kernel densities of the MPG of Other Vehicles covariate across hybrid (treated) and non-hybrid (control) samples for Models 1 and 2 in Appendix B, Table B2.

### 3.2 Using Linear Regression to Adjust for Imbalance in the Prius Treatment Model

As indicated, we find that some of the covariates have normalized differences that are larger than 0.1 in post-match for the Prius treatment model. Since these normalized differences are still below 0.25, we run linear regressions on the matched samples to assess the robustness of our *ATT* estimates. By the rule-of-thumb given in Imbens and Rubin (2015), linear regression should be able to adjust for any remaining imbalance so long as the normalized differences are below 0.25.

In Table A7 we report linear regressions of annual miles traveled on the Prius indicator and other control covariates using the matched samples from the two Prius treatment models in Table 4 in the manuscript. A few covariates are statistically significant with the expected sign, but the Prius treatment indicator is insignificant for both models, which is consistent with our estimates from the matching models. Despite the lack of precise balance in the matched Prius treatment samples, our *ATT* estimates do not appear to be biased.

**Table A7**: OLS Estimates of Annual Miles Traveled for Prius Treatment Models with Matched Samples

| | Model 1 | Model 2 |
|---|---|---|
| Constant | -22,848.26 (14,573.30) | -19,491.18 (14,553.53) |
| Prius Indicator | -260.00 (796.23) | 40.34 (797.86) |
| Middle Income | 2,048.72 (2,287.57) | 1,864.93 (2,372.01) |
| High Income | 2,671.39 (2,319.38) | 2,634.65(2,390.00) |
| High School Degree | 8,446.55 (8,078.10) | 8,322.86 (8,014.11) |
| Associate's Degree | 6,842.69 (7,384.57) | 7,614.80 (7,377.64) |
| Bachelor's Degree | 9,705.27 (7,351.00) | 9,702.06(7,320.38) |
| Graduate Degree | 10,260.28 (7,339.62) | 10,403.37 (7,306.44) |
| No. of Vehicles | 8,090.27*** (777.24) | 7,979.84*** (782.41) |
| Household Size | 562.45 (495.16) | 428.01 (495.13) |
| Average Age | 476.70* (245.61) | 442.67* (248.43) |
| Average Age Squared | -5.38** (2.29) | -5.13** (2.32) |
| Share of Female Drivers | -1,534.08 (2,165.42) | -1,521.81 (2,151.28) |
| Internet Usage | 6,073.75* (3,680.29) | 6,303.53* (3,664.49) |
| Average Vehicle MPG | 48.08 (76.72) | 39.74 (76.42) |
| Commute Distance | 212.01*** (23.80) | 207.99*** (24.05) |
| Gas Price | -2,160.29 (2,261.09) | -2,579.29 (2,248.73) |
| Urban | 810.77 (1,135.31) | 740.36 (1,150.62) |
| Mid-Size MSA | 2,431.20** (959.16) | 2,321.47** (953.45) |
| Small MSA | 2,206.38 (1,455.96) | 2,013.66 (1,443.14) |
| Not in MSA | 5,575.72*** (2,008.83) | 5,874.56** (2,411.75) |
| Observations | 676 | 660 |
| Year Fixed Effects | Yes | Yes |
| $R^2$ | 0.39 | 0.37 |
| Adjusted $R^2$ | 0.36 | 0.35 |
| Residual Std. Error | 9,982.39 | 9,894.45 |
| F Statistic | 16.30*** | 15.05*** |

Middle income is defined as income between $50,000 and $100,000 per year, and high income is defined as annual household income above $100,000. Statistical significance at the 10, 5, and 1 percent level is denoted with ∗, ∗∗, and ∗∗∗, respectively.

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