

Online Appendix for Paper “The End of the
Express Road for Hybrid Vehicles: Can
Governments’ Green Product Incentives
Backfire?”

Online Appendix A: List of Green Vehicle Models

Table A.1: List of Green Vehicles in Our Analysis Period for the HOV Incentive Termination

	Hybrid	Plug-in Hybrid	Electric
BMW ActiveHybrid 750I	Lexus HS 250H	Chevrolet Volt	Nissan LEAF
BMW ActiveHybrid 750LI	Lexus LS 600H L		
Cadillac Escalade Hybrid	Lexus RX 450H		
Chevrolet Silverado 1500 Hybrid	Lincoln MKZ Hybrid		
Chevrolet Tahoe Hybrid	Mercedes-Benz S400 Hybrid		
Ford Escape Hybrid	Mercury Mariner Hybrid		
Ford Fusion Hybrid	Mercury Milan Hybrid		
GMC Sierra 1500 Hybrid	Nissan Altima Hybrid		
GMC Yukon Denali Hybrid	Porsche Cayenne Hybrid		
GMC Yukon Hybrid	Toyota Camry Hybrid		
Honda CR-Z	Toyota Highlander Hybrid		
Honda Civic Hybrid	Toyota Prius		
Honda Insight	Volkswagen Touareg Hybrid		
Lexus GS 450H			

Online Appendix B: Criteria for Determining Isolated Markets

Table B.1: Isolated Market Criteria

Population in CBSA (Thousands)	Minimum distance (in miles) to a CBSA with the following populations, Pop			
	Pop > 50	Pop > 100	Pop > 200	Pop > 500
[0,100]	50	50	100	100
[100,200]	-	50	100	100
[200,500]	-	-	50	100
500+	-	-	-	100

Notes: The above criteria are adapted from Olivares and Cachon (2009). A CBSA with population indicated in the first column is included in our analysis sample if it satisfies the criteria shown in the other columns.

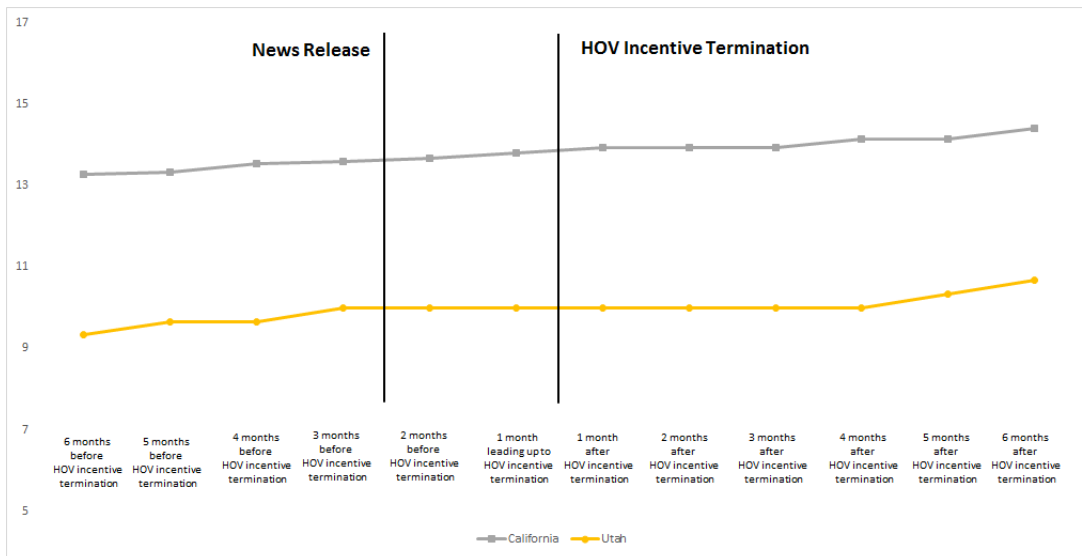
Online Appendix C: Other Potential Changes Around the HOV Incentive Termination

In this Online Appendix, we examine other potential changes around the HOV incentive termination that might confound the relationship between vehicle sales and the termination of the HOV incentive in California and Utah. Specifically, we first investigate whether there is any sharp change in the

number of charging stations around the HOV incentive termination. As shown in Figure C.1, the availability of charging stations does not change discontinuously around the HOV incentive termination. We account for the gradual changes in the number of charging stations by explicitly controlling for it in our empirical specifications.

Next, following the approach used by earlier studies (e.g., Tirunillai and Tellis 2017), we search for news articles on Factiva for potential news about major changes related to infrastructure or other adoption barriers for green vehicles. In particular, we collect data on the news reported in the two states where the HOV incentive is terminated, i.e., California and Utah, from April 2011 to August 2011. We use the following search terms: “charging station,” “HOV,” “electric vehicle infrastructure,” “Assembly Bill 2628,” “Toyota Prius,” “Honda Insight,” and “Honda Civic-hybrid.” The search results did not provide any evidence of major changes around the HOV incentive termination.

Figure C.1: The Average Number of Charging Stations by County-Month in California and Utah



Online Appendix D: Difference-in-Differences Without Matching

Table D.1: Robustness to Difference-in-Differences Without Matching

Dependent variable: Unit sales	HOV termination			HOV launch		
	Green vehicles - covered	Green vehicles - not covered	Gasoline vehicles	Green vehicles - covered	Green vehicles - not covered	Gasoline vehicles
HOV incentive termination	-0.207*** (0.072)	-0.290 (0.457)	0.014 (0.023)			
HOV incentive launch				0.032 (0.037)	0.098 (0.144)	0.015 (0.075)
Dummies: Stratum × vehicle model, county, vehicle model × month	Yes	Yes	Yes	Yes	Yes	Yes
Control variables (see the notes below)	Yes	Yes	Yes	Yes	Yes	Yes
Number observations	16,656	1,662	746,354	119,342	51,927	3,281,511
Log likelihood	-17,711	-1,084	-631,127	-119,846	-34,574	-3,482,724

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Clustered standard errors (county) are reported in parentheses. Control variables include vehicle price, state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Online Appendix E: Additional Robustness Checks

Falsification Exercise

We also perform a “falsification” test to alleviate any remaining concerns about endogeneity following earlier studies (e.g., Ozturk et al. 2016). Specifically, we re-estimate our main specifications for the two incentive changes to see whether there is a “treatment” group effect in a period when there is no incentive change—i.e., before May 2011. To do this, we use all the pre-incentive-change data and divide that into two halves, namely before and after the placebo incentive change. Then we test whether the coefficient for the placebo incentive change is significant. If we were to find a significant coefficient for the placebo incentive change on unit sales of green vehicles covered by the incentive in a period when no incentive change happens, this would suggest that unobservable differences that are correlated with incentive changes are contributing to our estimated effects. The results of this falsification exercise are reported in Table E.3. Column (1) indicates that the

estimate for the placebo HOV incentive termination variable is insignificant. This falsification test reinforces the causal interpretation of our main effect estimate.

Different Treatment States

In our analyses of the HOV incentive launch and termination, we exploit incentive changes in two states, i.e., California and Utah. Given the leading role of California (which was the focal state in most of the previous studies) in the green movement, one might think that our results so far could be primarily driven by California, rather than Utah. To assess this possibility, we also investigate the impact of HOV incentive termination in California and Utah separately. The results associated with this analysis are provided in Table E.4. Our results indicate that HOV incentive termination hurts unit sales of green vehicles covered by the incentive change not only in California but also in Utah, albeit with a marginal significance.

Differential Trends Across Strata

To examine potential concerns regarding differential trends across strata, we repeat our estimation by adding strata-monthly trend interactions to our main specification in Equation 1. These interactions can capture gradually changing differential trends in variables such as gas prices or traffic patterns across strata. The results of this estimation are reported in Table E.5. The estimates show that our key finding is robust even after we allow for differential time trends across strata.

Alternative Treatment Dates

California and Utah made announcements before the actual enactment of the HOV incentive termination. As such, the date of enactment might not give a precise measurement of the effect of the HOV incentive termination due to consumers' anticipation of the incentive change. Therefore, in our main specifications, we use DMV and UDOT's announcements of the HOV incentive termination as the treatment. In Table E.6, we use the enactment of the HOV incentive termination as the treatment, and our results remain robust. Additionally, our conclusion does not change when we replicate this analysis after dropping the two months between the announcement and the enactment of the HOV incentive termination.

Table E.1: The Impact of HOV Incentive Termination - Robustness to Various Specifications

	Unit sales of green vehicles covered by HOV incentive termination			
HOV incentive termination	-0.339*** (0.077)	-0.308*** (0.079)	-0.380*** (0.054)	-0.155** (0.062)
Price		-0.045*** (0.002)	-0.023** (0.007)	-0.015* (0.008)
Stratum \times vehicle model dummies	No	No	Yes	Yes
Vehicle model \times month dummies	No	No	No	Yes
Control variables (see the notes below)	No	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Number of observations	7,420	7,420	7,420	7,420
Log likelihood	-8,459	-8,173	-6,746	-6,453

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Table E.2: The Impact of HOV Incentive Termination - Robustness to Other Functional Forms

	Unit sales of green vehicles covered by HOV incentive		Unit sales of green vehicles not covered by HOV incentive		Unit sales of gasoline vehicles	
	(1) Log-linear regression model	(2) Poisson model	(3) Log-linear regression model	(4) Poisson model	(5) Log-linear regression model	(6) Poisson model
HOV incentive termination	-0.084* (0.039)	-0.206*** (0.045)	-0.028 (0.198)	-0.652 (0.708)	-0.007 (0.008)	0.022 (0.014)
Price	-0.005+ (0.003)	-0.016* (0.007)	-0.008 (0.015)	-0.087* (0.044)	-0.007*** (0.001)	-0.032*** (0.001)
Stratum \times vehicle model dummies	Yes	Yes	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle model \times month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	7,420	7,420	232	232	77,713	77,713
R square	0.629		0.558		0.530	
Log likelihood		-6,543		-248		-121,728

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. This table shows the robustness of the impact of HOV incentive termination to different functional forms. The dependent variable for the log-linear regression models is $\log(\text{unit sales}+1)$. The Poisson models use the log link. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Table E.3: Falsification Exercise

	(1) Falsification
Placebo treatment	0.114 (0.153)
Price	-0.003 (0.013)
Stratum \times vehicle model dummies	Yes
County dummies \times month	Yes
Vehicle model \times Month dummies	Yes
Control variables (see the notes below)	Yes
Number of observations	2,378
Log-likelihood	-2,293

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. This table shows the results from the falsification exercise for HOV incentive termination. March 2011 is the time of placebo treatment. We have 2 months (January and February 2011) as the pre-placebo-treatment period and 2 months (March and April 2011) as the post-placebo-treatment period. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute. Since our analyses use observations from the same year and we control for county fixed effects, all control variables at the county-year level are dropped.

Table E.4: The Impact of HOV Incentive Termination in Different States

	Unit sales of green vehicles covered by HOV incentive		Unit sales of green vehicles not covered by HOV incentive		Unit sales of gasoline vehicles	
	California	Utah	California	Utah	California	Utah
HOV incentive termination	-0.160** (0.065)	-0.093+ (0.057)	-0.427 (0.531)	-1.063 (2.752)	0.005 (0.021)	0.030 (0.043)
Price	-0.016* (0.008)	-0.038 (0.036)	-0.107* (0.048)	-0.077+ (0.048)	-0.024*** (0.001)	0.007* (0.003)
Stratum \times vehicle model dummies	Yes	Yes	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes	Yes	Yes
Vehicle model \times month dummies	Yes	Yes	Yes	Yes	Yes	Yes
Control variables (see the notes below)	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	7,022	398	184	48	68,896	8,817
Log likelihood	-5,907	-424	-205	-103	-93,650	-13,030

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. This table shows the estimation results of the impact of HOV incentive termination on green vehicles covered by the incentive change for California and Utah, separately. We use the same identification specification of Equation 1. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Table E.5: HOV Incentive Termination - Robustness to Differential Trends Across Strata

	(1) Unit sales of green vehicles covered by HOV incentive	(2) Unit sales of green vehicles not covered by HOV incentive	(3) Unit sales of gasoline vehicles
HOV incentive termination	-0.217** (0.068)	-0.073 (0.754)	0.002 (0.024)
Price	-0.015* (0.008)	-0.046 (0.055)	-0.022*** (0.001)
Stratum \times vehicle model dummies	Yes	Yes	Yes
Stratum dummies \times month	Yes	Yes	Yes
Vehicle model \times month dummies	Yes	Yes	Yes
Control variables (see the notes below)	Yes	Yes	Yes
Number of observations	7,420	232	77,713
Log likelihood	-6,414	-212	-107,893

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. This table shows the robustness of the impact of HOV incentive termination to differential linear trends across strata. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Table E.6: The Impact of HOV Incentive Termination - Robustness to a Different Treatment Date

	(1) Unit sales of green vehicles covered by HOV incentive termination	(2) Unit sales of green vehicles not covered by HOV incentive termination	(3) Unit sales of gasoline vehicles
HOV incentive termination	-0.090* (0.050)	-0.504 (0.620)	0.033 (0.028)
Price	-0.014* (0.007)	-0.088* (0.044)	-0.022*** (0.001)
Stratum \times vehicle model dummies	Yes	Yes	Yes
County dummies	Yes	Yes	Yes
Vehicle model \times month dummies	Yes	Yes	Yes
Control variables (see the notes below)	Yes	Yes	Yes
Number of observations	7,420	232	77,713
Log likelihood	-6,455	-247	-107,941

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. This table displays the results of Equation 1, which measures the average effect of HOV incentive termination on green vehicles covered by the incentive change (i.e., hybrid vehicles), green vehicles not covered by the incentive change (i.e., plug-in hybrid vehicles and electric vehicles), and gasoline vehicles, respectively. Here, instead of using the date of news release as our treatment start date, we use the enactment of HOV incentive termination. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Online Appendix F: Additional Details on the Border Analysis

For our border analysis, we use counties in the following states neighboring California and Utah as our control group: Oregon, Nevada, Arizona, and Colorado (see Figure F.1). The data for our border analysis contain 37 counties across 16 markets. The unit of analysis for our border strategy is county - vehicle model - month. To estimate the effect of the HOV incentive termination using the border strategy, we use the following specification:

$$\begin{aligned} \ln(\text{Unit Sales}_{ijt}) &= \beta_{HOV\ term}^{border} HOV\ termination_{it} \\ &+ \alpha_{c(i)j} + \lambda_t + X'_{ijt}\gamma + \varepsilon_{ijt}. \end{aligned} \tag{4}$$

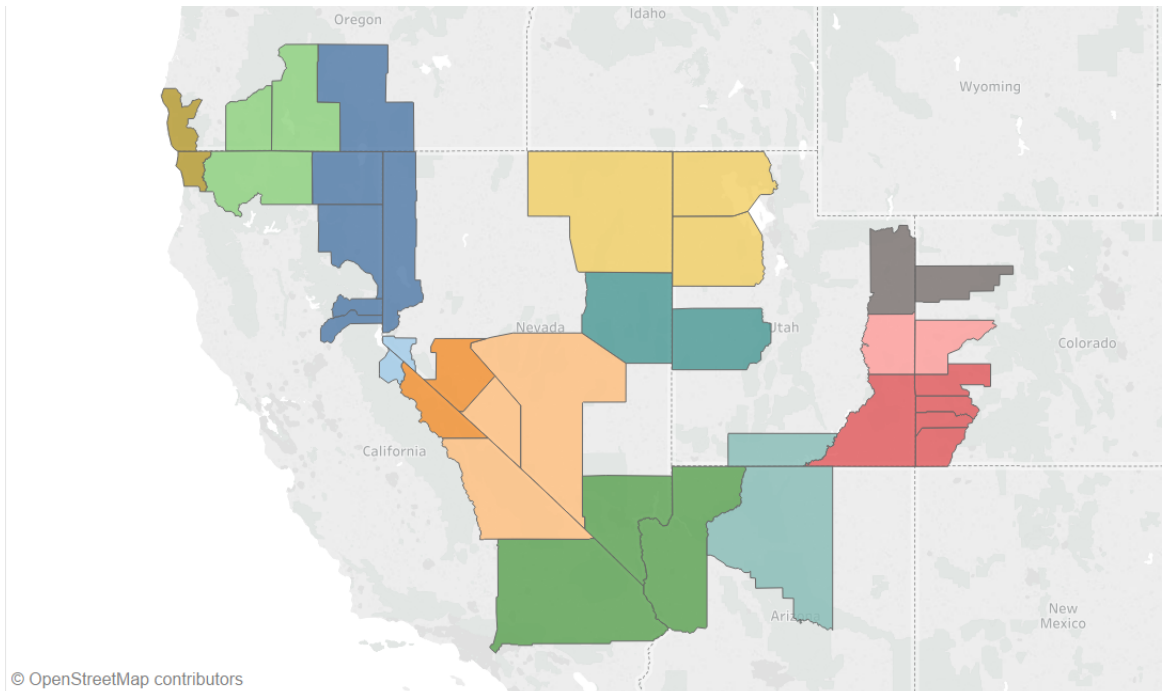
The dummy variable $HOV\ termination_{it}$ is equal to 1 after the HOV incentive termination is announced if a given county belongs to a state where there is an HOV incentive termination, and 0 otherwise. The index $c(i)$ shows the market to which county i belongs. Market-vehicle model fixed effects, $\alpha_{c(i)j}$'s, allow the baseline unit sales of each vehicle model to vary across markets. Month fixed effects λ_t capture common time-variant unobservables. The vector X_{ijt} includes county-level demographic controls, including income, education, age, gender, unemployment rate, percentage of votes for the Democratic Party, and commute. The vector X_{ijt} also involves the average transaction price of a vehicle model j in county i in month t , monthly average gas price in each state, and the number of charging stations at the county-month level. $\beta_{HOV\ term}^{border}$ captures the impact of HOV incentive termination on unit sales.

Table F.1: The Impact of HOV Incentive Termination on Unit Sales - Border Strategy

	Green vehicles - covered	Green vehicles - not covered	Gasoline vehicles
HOV incentive termination	-0.452** (0.158)	0.133 (26.937)	-0.019 (0.025)
CBSA × vehicle model dummies	Yes	Yes	Yes
Month dummies	Yes	Yes	Yes
Control variables (see the notes below)	Yes	Yes	Yes
Number of observations	674	84	30,462
Log likelihood	-597	-105	-32,906

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Clustered standard errors (CBSA) are reported in parentheses. Control variables include average vehicle price, state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, percentage of votes for the Democratic Party, and commute.

Figure F.1: Map of Counties Used for the Border Analysis



Notes: Counties with the same color are in the same market.

Online Appendix G: Additional Details on the RDiT-style Analyses

To estimate the effects of the HOV incentive termination using an RDiT-style approach, we estimate the following specification:

$$\begin{aligned} \text{Unit Sales}_{ijt} = & \beta_{HOV\text{ termination}}^{RDiT} \text{HOV termination}_t + f(t) \\ & + \alpha_i + \delta_j + X'_{ijt}\gamma + \varepsilon_{ijt}. \end{aligned} \tag{G.5}$$

HOV termination_t is a dummy variable that is equal to 1 after the announcement of the HOV incentive termination, and 0 otherwise. $f(t)$ is a flexible polynomial (e.g., linear or quadratic) time trend that allows for separate trends on either side of the incentive change period. County fixed effects, α_i 's, account for the impact of time-invariant county-level factors on unit sales. Vehicle model fixed effects, δ_j 's, capture time-invariant vehicle model characteristics such as manufacturer, brand, and nameplate. The vector of control variables X_{ijt} includes the average transaction price of a vehicle model j in county i in month t as well as the number of charging stations in county i in month t . The key coefficient of interest is $\beta_{HOV\text{ termination}}^{RDiT}$, which measures the impact of the HOV incentive termination on unit sales of the three vehicle types.

Table G.1: The Impact of HOV Incentive Termination on Unit Sales - RDiT-Style Analysis

	Unit sales of green vehicles - covered			
	4 weeks	8 weeks	12 weeks	16 weeks
Incentive change dummy	-0.220+	-0.376*	-0.292*	-0.355*
	(0.121)	(0.060)	(0.044)	(0.038)
Number of observations	1,135	2,085	3,068	3,973
	Unit sales of green vehicles - not covered			
	4 weeks	8 weeks	12 weeks	16 weeks
Incentive change dummy	0.228	0.097	-0.060	-0.019
	(0.523)	(0.109)	(0.065)	(0.081)
Number of observations	133	236	306	372
	Unit sales of gasoline vehicles			
	4 weeks	8 weeks	12 weeks	16 weeks
Incentive change dummy	-0.001	0.007	0.002	-0.008
	(0.011)	(0.014)	(0.001)	(0.008)
Number of observations	33,113	60,604	89,493	116,058

Notes: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001. All estimations are based on the local linear approach (with separate trends pre- and post-incentive changes) using a rectangular kernel. Clustered standard errors (county) are reported in parentheses. Our findings remain robust when we use a second order polynomial (not reported due to space constraints).

Online Appendix H: Additional Discussion on an Alternative Explanation for the HOV Incentive Termination Effect

The logic behind the “pending availability of an HOV incentive for plug-in hybrids” explanation implies that the closer consumers get to the actual launch of the future HOV incentive, the higher the value from waiting because they will incur lower costs of waiting as they need to wait for fewer periods. Therefore, if this explanation played a major role in the sales decline for the hybrid vehicles around the HOV incentive termination, one would expect that the sales decline will be more pronounced as one gets closer to the launch of the future HOV incentive (i.e., September 2012). However, as shown in Figure 1, the negative effect of the HOV termination does not become more negative over time.

Furthermore, existing plug-in hybrid and electric vehicles at the time of the HOV incentive termination are also potential substitutes for future greener models with HOV lane access. As such, if consumers decided to wait for greener future plug-in models to come out to get a decal following the HOV termination for conventional hybrids, one would also expect to see a significant sales decline for existing plug-in hybrid and electric vehicles around the HOV incentive termination. However, as shown in Column (2) of Table 2, we do not find a significant sales effect of the HOV incentive termination on those vehicles. Additionally, it is important to note that, in Utah, there were no plans to offer the HOV incentive for other types of green cars following the termination of the HOV incentive for conventional hybrid cars. As discussed in Online Appendix E, we find a negative sales effect of the HOV incentive termination, albeit marginally significant, even in Utah, where there was no pending HOV incentive. Combined, the aforementioned analyses and discussions suggest that the future availability of an HOV incentive for newer plug-in hybrids might not be playing a primary role in the significant and sharp decline in sales for conventional hybrids around the HOV incentive terminations.

Online Appendix I: HOV Incentive Launch: Additional Analyses

Table I.1: The Impact of HOV Incentive Launch - Robustness to Various Specifications

	Unit sales of green vehicles covered by HOV incentive launch			
HOV incentive launch	0.181 (0.268)	0.391 (0.264)	0.361 (0.215)	0.016 (0.183)
Price		-0.061*** (0.003)	-0.047*** (0.004)	-0.010*** (0.004)
Stratum \times vehicle model dummies	No	No	Yes	Yes
Vehicle model \times month dummies	No	No	No	Yes
Control variables (see the notes below)	No	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Number of observations	25,932	25,860	25,860	25,860
Log likelihood	-34,434	-33,969	-29,780	-28,861

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Table I.2: The Impact of HOV Incentive Launch - Robustness to Other Functional Forms

	Unit sales of green vehicles covered by HOV incentive		Unit sales of gasoline vehicles	
	(1) Log-linear regression model	(2) Poisson model	(3) Log-linear regression model	(4) Poisson model
HOV incentive launch	0.042 (0.078)	0.008 (0.153)	-0.020 (0.013)	0.017 (0.011)
Price	-0.001 (0.001)	-0.010** (0.004)	-0.002* (0.001)	-0.016*** (0.001)
Stratum \times vehicle model dummies	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Vehicle model \times month dummies	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes
Number of observations	25,860	25,860	62,367	62,367
R square	0.703		0.640	
Log likelihood		-29,654		-116,387

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. The dependent variable for the log-linear regression models is $\log(\text{unit sales} + 1)$. The Poisson models use the log link. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Table I.3: The Impact of HOV Incentive Launch in Different States

	Unit sales of green vehicles covered by HOV incentive		Unit sales of gasoline vehicles	
	California	Utah	California	Utah
HOV incentive launch	-0.049 (0.104)	0.028 (0.226)	0.022 (0.023)	-0.094 (0.052)
Price	-0.069* (0.027)	-0.002 (0.006)	-0.004* (0.002)	-0.002 (0.003)
Stratum \times vehicle model dummies	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Vehicle model \times month dummies	Yes	Yes	Yes	Yes
Control variables (see the notes below)	Yes	Yes	Yes	Yes
Number of observations	324	25,536	50,449	11,918
Log likelihood	-629	-28,222	-89,495	-12,754

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. This table shows the estimation results of the impact of HOV incentive launch on green vehicles covered by the incentive change for California and Utah, separately. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Table I.4: The Impact of HOV Incentive Launch - Robustness to Differential Trends Across Strata

	(1) Unit sales of green vehicles covered by HOV incentive	(2) Unit sales of gasoline vehicles
	HOV incentive launch	-0.003 (0.091)
Price	-0.024*** (0.007)	-0.004** (0.002)
Stratum \times vehicle model dummies	Yes	Yes
Stratum dummies \times month	Yes	Yes
Vehicle model \times month dummies	Yes	Yes
Control variables (see the notes below)	Yes	Yes
Number of observations	25,860	62,367
Log likelihood	-28,845	-101,152

Notes: + $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. This table shows the robustness of the impact of HOV incentive launch to differential linear trends across strata. Clustered standard errors (county) are reported in parentheses. Control variables include state-month-level average gasoline price, county-month-level number of charging stations, and county-level demographic variables that change annually: income, education, age, gender, unemployment rate, and commute.

Online Appendix J: Additional Discussion on an Alternative Explanation for the HOV Incentive Launch Effect

We also consider an alternative explanation for the insignificant effect of the HOV incentive launch on conventional hybrid sales. According to this explanation, the “greenness” signal provided by conventional hybrid vehicles could be weakened by the pending availability of greener electric vehicle models, resulting in fewer sales for conventional hybrids following the HOV incentive launch. To empirically assess whether the above mechanism could explain the insignificant effect of the HOV incentive launch on conventional hybrid sales, we have examined this effect only for California.

Specifically, we aim to exploit the fact that the HOV incentive was launched in California in July 2005 and the first mass-produced plug-in hybrids (e.g., Chevy Volt) and all-electric vehicles (e.g., Nissan Leaf) did not become available until December 2010. In other words, given the long period between the launch of the HOV incentive in California and the availability of more green electric vehicles, it is reasonable to think that the above explanation should be largely inoperative around the HOV incentive launch in California.

Recall that our explanation for the insignificant effect of the HOV incentive launch on hybrid sales is that an increase in functional value after the incentive launch is canceled out by a reduction in symbolic value due to the incentive launch. In contrast, the above alternative explanation suggests that the increase in functional value after the incentive launch could have been counterbalanced by pending greener vehicles, rather than the incentive launch itself. If this alternative explanation were a major driver of our insignificant sales effect finding, it would be more likely to observe a more positive (and maybe even significant) effect of the HOV incentive launch in California, where the above mechanism is expected to be largely absent. In contrast, as shown in Table I.3 in Online Appendix I, the coefficient for the HOV incentive launch becomes more negative (-.049) and remains insignificant ($p > .10$) when we only examine California. Therefore, we do not find empirical support for the explanation that the “greenness” signal provided by conventional hybrid vehicles could be weakened by the pending availability of greener electric vehicle models.

Also, if the above explanation were at work, one would expect to see a more pronounced decline in the sales of conventional hybrids over time, i.e., as one gets closer to the launch of greener electric vehicle models. However, as shown in Column (2) in Table 4, the effect of the launch

remains insignificant when we extend the post-launch window from 6-months to 12-months. This result is robust to an even wider 18-month post-launch window.

Our additional analyses (not reported due to space constraints) suggest that the pending availability of greener electric models does not appear to influence our termination-related findings either. These analyses are available from the authors upon request.