



Insurance losses – comparison of electric vehicles and their conventional counterparts while adjusting for mileage

► Summary

Unlike conventional and hybrid vehicles, electric vehicles are powered exclusively by electricity stored in batteries. They do not directly consume any fossil fuel and thus have a limited range without recharging the batteries. In 2015, the Highway Loss Data Institute (HLDI) first published insurance loss results comparing electric vehicles with their conventional counterparts (HLDI, 2015). That research found collision, property damage liability, and comprehensive claim frequencies for electric vehicles with gasoline powered variants and the Nissan Leaf to be lower than their comparison vehicles. The results for Tesla differed.

This analysis compares insurance losses for electric vehicles and their conventional counterparts under collision and property damage liability. Claim frequencies were calculated both with and without controlling for vehicle miles traveled. The mileage information was made available through a cooperative agreement with CARFAX®. CARFAX is a unit of IHS Inc. and provides vehicle history reports. The electric series vehicles in this analysis and the Nissan Leaf were found to be driven about 30 percent fewer miles per day than their conventional counterparts. The Tesla Model S, however, is driven differently and accumulates about 10 percent more miles per day than other midsize luxury cars.

Under the studied coverage types, the change in claim frequency for the electric vehicles with gasoline powered variants and the Nissan Leaf were not as large once mileage was included in the regression model. The change in claim frequencies for the Tesla Model S however, were larger than those for the comparison vehicles once miles per day were included. The Tesla was unique among electric vehicles in that miles per day was higher for the Tesla than its gas powered counterparts (large luxury cars). However, the miles per day for Teslas is still below the miles per day for all vehicles. Since the Tesla Model S was found to travel more miles per day than conventional large luxury cars, it would be expected that the difference in claim frequency would get smaller. Since that did not happen it may be that the Tesla Model S is simply driven very differently. It may be that the driver differences between the Tesla Model S and conventional mid-size luxury cars can not be controlled for with the variables available in the HLDI database.

Change in claim frequency, electric versus conventional counterparts			
	Claim frequency without mileage	Claim frequency with mileage	Percent difference
Collision			
Electric series	-19.3%	-14.1%	-27.2%
Nissan Leaf	-13.6%	-6.8%	-49.7%
Tesla Model S	31.3%	36.9%	17.9%
Property damage liability			
Electric series	-17.2%	-13.3%	-22.5%
Nissan Leaf	-30.7%	-24.7%	-19.5%
Tesla Model S	12.0%	14.2%	18.3%

► Introduction

The first all-electric vehicle available for sale to consumers in the United States was the 2008 Tesla roadster electric convertible. Since then, the number of all-electric vehicles for sale has increased to 15 models in the 2016 model year.

In 2015, the Highway Loss Data Institute (HLDI) first published the loss experience of electric cars in direct comparison with their non-electric counterparts. This bulletin updates the prior analysis for collision and property damage liability while also producing results that adjust for miles traveled. Results for the corresponding non-electric versions were included for comparison. A counterpart shares the same platform and has the same nameplate with its electric version and is produced by the same manufacturer. Only true electric vehicles were included in this study. The Chevrolet Volt, which can be powered by electricity or gasoline (when the battery is depleted), was not included. In addition, the analysis compared the Nissan Leaf to the Nissan Versa and the Tesla Model S to all large luxury cars.

► Method

Insurance data

Automobile insurance covers damage to vehicles and property as well as injuries to people involved in crashes. Different insurance coverages pay for vehicle damage versus injuries, and different coverages may apply depending on who is at fault and the state where the vehicle is insured.

When a vehicle collides with another vehicle or object, the damage to the at-fault vehicle is covered by its driver's collision insurance, whereas the damage inflicted to another vehicle or to other property is covered by the at-fault driver's property damage liability insurance.

Mileage data

The linking of mileage data and HLDI insurance data was made possible through a cooperative agreement with CARFAX. Vehicle identification numbers (VINs) from the HLDI database were matched to odometer readings from CARFAX. Odometer readings came from multiple sources including title transfers, yearly inspections, and routine maintenance service. The frequency of odometer readings varied widely. Some vehicles had just one or two odometer readings, while others had numerous records (e.g., every oil change and state inspection).

Miles per day was computed for each day of exposure by taking the ratio of the increase in miles from two consecutive odometer readings to the number of days between the two readings. When more than one mileage reading was available, miles per day was calculated for each pair. For example, the days between mileage readings 1 and 2 could be assigned different miles per day than the days between mileage readings 2 and 3. The different daily averages were assigned to the corresponding periods of matching collision coverage.

Vehicles studied

For the purpose of this analysis, the electric vehicles studied were classified into three groups. The first consisted of electric vehicles with an exact conventional counterpart. To be included, an electric series had to have an exact conventional counterpart with a gasoline powered engine. The electric series and its counterpart shared the same platform and nameplate. Model years were limited to those where both the electric and conventional versions were available. A total of seven vehicle pairs were included in this segment, with model years ranging from 2011 to 2015.

The second group was the Nissan Leaf. It was compared with the Nissan Versa hatchback, which although different from the Leaf, is of a similar size and body style. The model years included 2011–12 and 2014–15. The 2013 model year was excluded because the Nissan Versa hatchback was not produced that year.

The third group also had one electric series, the Tesla Model S. Tesla only produces electric vehicles, and consequently there are no Tesla vehicles that are suitable comparison vehicles. The Tesla Model S was compared with other conventional large luxury cars. Model years were limited to 2012–15. **Table 1** lists the vehicles studied in this bulletin.

Table 1: Electric vehicles and their conventional counterparts

Model years	Make	Electric series	Conventional series
2011	BMW	1 Series Active E 2dr	128 I 2dr
2014–15	Chevrolet	Spark EV electric 5dr	Spark 5dr
2013–15	Fiat	500 Electric 2dr	500 2dr
2012–15	Ford	Focus electric 5dr	Focus 5dr
2011, 13–15	Smart	Electric drive 2dr	ForTwo 2dr
2013–15	Smart	Electric drive convertible	ForTwo convertible
2012–14	Toyota	RAV4 EV electric 5dr 2WD	RAV4 4dr 2WD
2011–12, 14–15	Nissan	Leaf electric 4dr	Versa hatchback
2012–15	Tesla	Model S electric 5dr	Conventional large luxury cars

Analysis methods

Regression analysis was performed for each of the three groups to compare insurance losses for the electric vehicles with their conventional counterparts while controlling for other covariates. Claim frequencies, claim severities, and overall losses were computed for collision and PDL coverages. Miles per day were included in the analysis for claim frequencies and thus overall losses.

HLDI normally separates vehicles of the same nameplate but with conventional or electric engines into different series. For example the Ford Focus five-door is a separate vehicle series from the Ford Focus five-door electric. For the purposes of this analysis, the conventional and electric counterparts with the same nameplate were combined into one series, that is, Ford Focus five-door. Combining these into a single series allowed for the regression model to control for factors common to both the conventional and electric versions. Based on the model year and the combined series, a single variable called SERIESMY was created for inclusion in the regression model. Effectively, this variable controlled for the variation caused by vehicle design changes that occur from model year to model year. In the second and third vehicle groups, this variable was simplified to model year since only one series was involved. The powertrain (electric or conventional) was then treated as a separate binary variable in the regression model to capture the difference between the electric vehicles and their comparators.

Other covariates included calendar year, garaging state, vehicle density (number of registered vehicles per square mile), rated driver age group, rated driver gender, rated driver marital status, deductible range (collision and comprehensive only), and risk. Reference categories for the categorical independent variables were assigned to the values with the highest exposure under each coverages. Common reference categories were: powertrain = traditional, rated driver age = 50–59 years old, gender = female, marital status = married, risk = standard, vehicle density = 1,000+, and calendar year = 2014.

Claim frequency was modeled using a Poisson distribution, claim severity was modeled using a Gamma distribution, and both used a logarithmic link function. Estimates for overall losses for collision and PDL were derived from the claim frequency and claim severity models. For space reasons, illustrative full regression results on collision claim frequency are shown in the **Appendix**. To further simplify the presentation here, the exponent of the parameter estimate was calculated, 1 was subtracted, and the result multiplied by 100. The resulting number corresponds to the effect of a given model variable on a loss measure. For example, the estimate of collision claim frequency for electric series in the first analysis was -0.2143, thus collision claim frequency is expected to be 19.3 percent lower than that of their exact conventional counterparts $((\exp(-0.2143) - 1) * 100 = -19.3)$.

Illustrated Vehicle Information

Table 2 shows the exposure of electric series and their conventional counterparts. With the exception of the Nissan Leaf and Tesla Model S, the table is sorted by descending conventional exposure. Electric series exposure makes up anywhere from 1 percent to as much as 14 percent of the total exposure. The Tesla Model S and its comparison vehicles had the highest exposure, nearly 1.1 million insured vehicle years combined, followed by the Ford Focus pair. It should be noted that the model years applied for each pair were not identical, thus exposure across the series pairs should not be compared directly.

	Electric exposure	Conventional exposure	Percent electric
Ford Focus 5dr	3,678	374,009	1%
Toyota RAV4 4dr 2WD	1,597	202,865	1%
Fiat 500 2dr	3,554	42,509	8%
Smart ForTwo 2dr	1,472	21,661	6%
Chevrolet Spark 5dr	841	15,250	5%
BMW 1 Series	931	14,056	6%
Smart ForTwo convertible	151	1,646	8%
Nissan Leaf-Nissan Versa	48,826	288,821	14%
Tesla Model S-Large luxury cars	29,087	1,060,550	3%

Figure 1 compares the average base price of the electric series with that of their counterparts. The average base price of electric vehicles was 78.7 percent higher than that of their conventional counterparts. The base price of the Nissan Leaf was 117.2 percent higher than that of the Nissan Versa. The base price of the Tesla Model S was 33.3 percent higher than that of conventional large luxury cars.

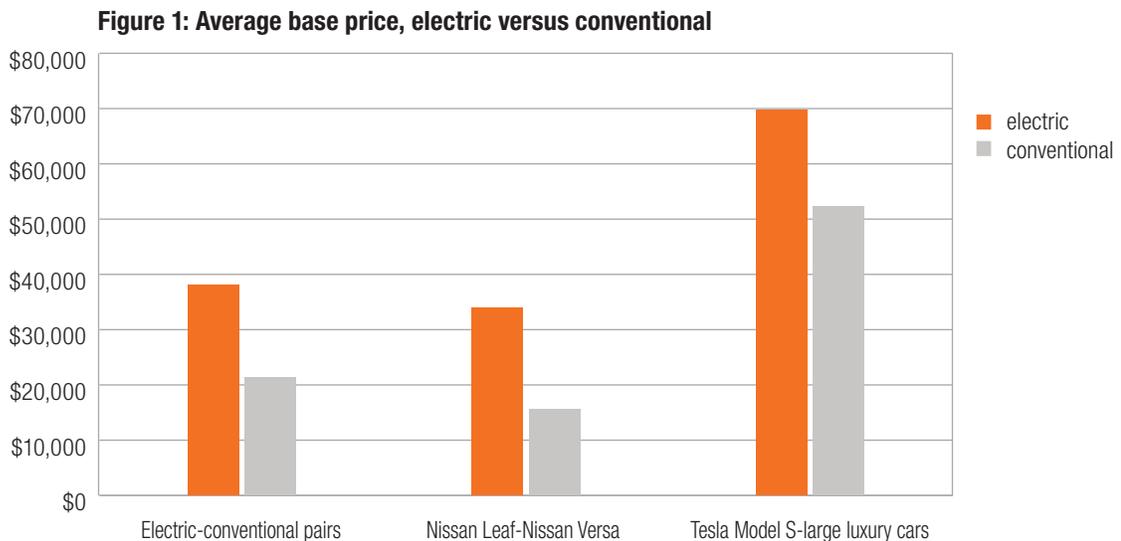
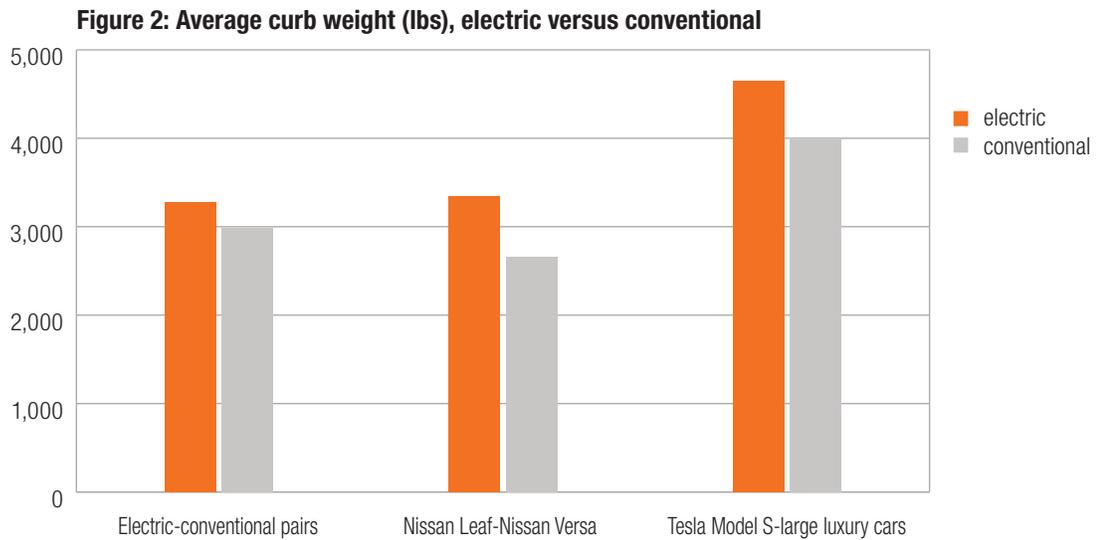


Figure 2 compares the average curb weight of electric series with that of their counterparts. The average curb weight of electric cars was 9.8 percent higher than that of their conventional counterparts. The curb weight of the Nissan Leaf was 25.6 percent higher than that of the Nissan Versa, and the curb weight of the Tesla Model S was 16.4 percent higher than that of conventional large luxury cars.



The comparison series for the Tesla Model S consisted of 82 individual large luxury cars. **Figure 3** displays the average base price and curb weight of the Tesla Model S within the segment using percentiles. About 60 percent of large luxury series had an average base price lower than that of the Tesla Model S and 97 percent of large luxury series had an average curb weight lower than that of the Tesla Model S.

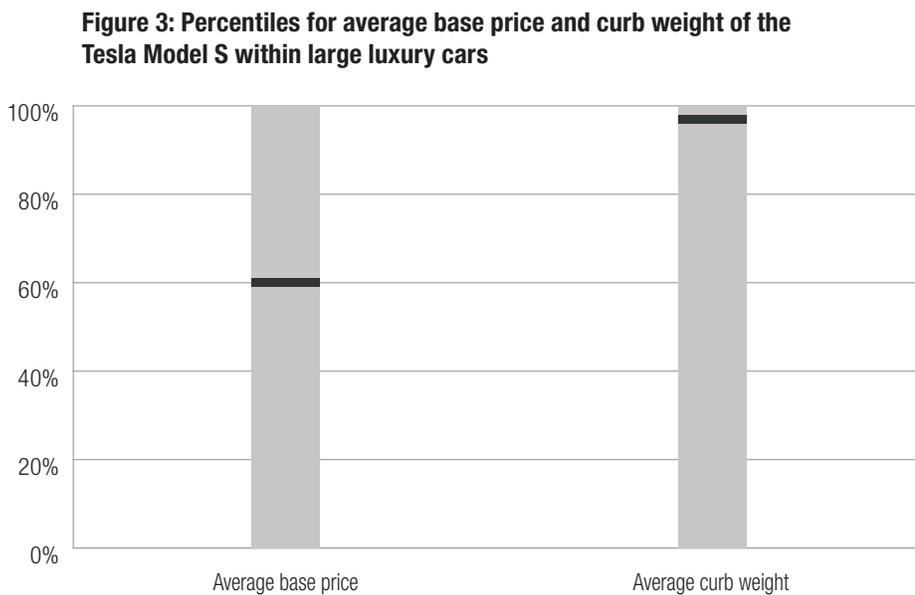


Figure 4 shows the average miles per day for the study vehicles. Both the electric series and the Nissan Leaf are used for fewer miles per day (11–12 miles fewer) than their conventional counterparts. The Tesla Model S, however, showed the opposite phenomenon. Teslas were found to travel 3 more miles per day than other large luxury cars.

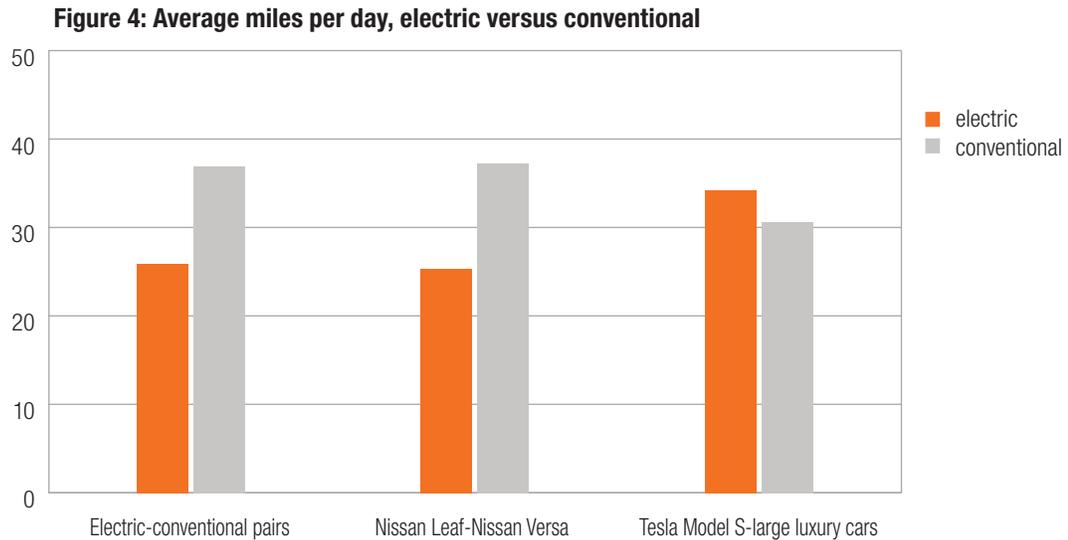


Figure 5 shows the estimated collision losses for the electric series versus their comparisons. When controlling for mileage, electric vehicles with an exact conventional counterpart were estimated to have lower collision claim frequency (-14.1 percent) and higher overall losses (8.2 percent) than their exact conventional counterparts. Claim severity, however, does not take mileage into account and resulted in a 25.9 percent increase. The claim frequency and claim severity estimates were statistically significant, whereas the estimate for overall losses was not. The Nissan Leaf was estimated to have a lower collision claim frequency (-6.8 percent) and lower overall losses (-12.2 percent) when mileage is incorporated into the model. Claim severity for the Nissan Leaf was also lower than for the Nissan Versa (-5.8 percent), but mileage was not included in this model. All of these estimates were statistically significant. The collision claim frequency for the Tesla Model S while adjusting for mileage was estimated to be 36.9 percent higher than that for the comparison group, as well as overall losses (123.9 percent higher). Claim severity, which did not include miles, was 63.5 percent higher. All Tesla Model S estimates were statistically significant.

Figure 5: Estimated collision losses of electric vehicles versus conventional counterparts

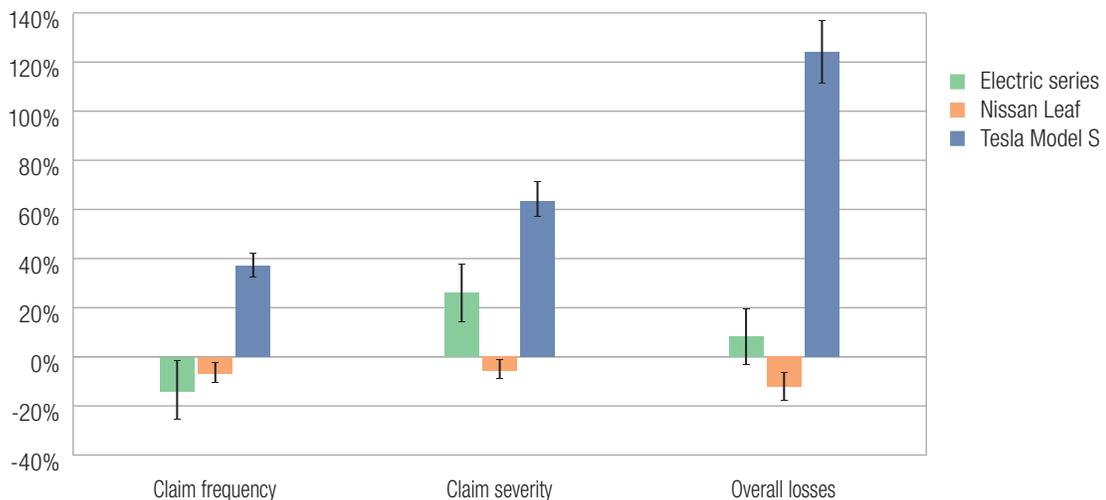
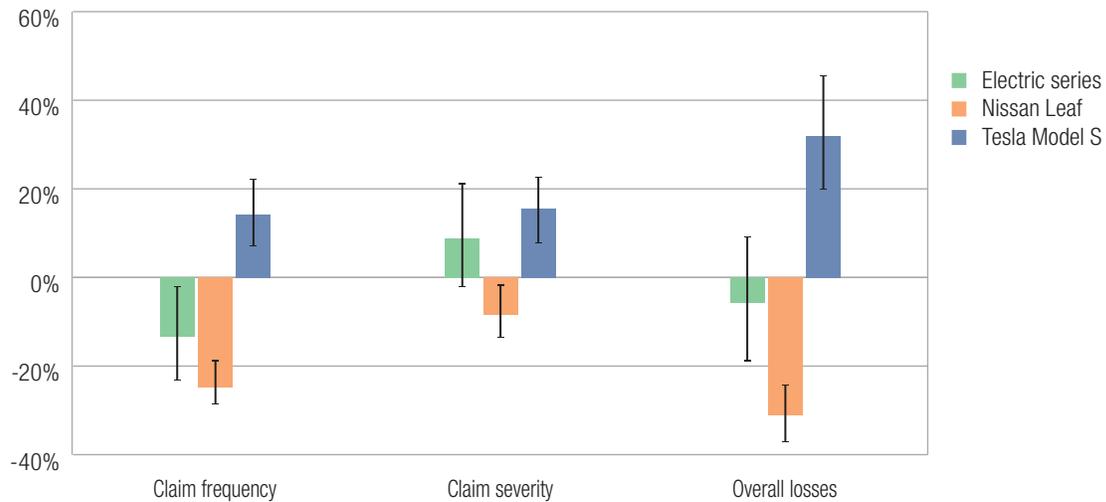


Figure 6 shows the estimated PDL losses for the electric series versus their comparisons. When controlling for mileage, electric vehicles with an exact conventional counterpart were estimated to have lower PDL claim frequency (-13.3 percent), and lower overall losses (-5.7 percent) than their exact conventional counterparts. Only the claim frequency estimate was statistically significant. Claim severity, however, does not take mileage into account and resulted in a non-significant 8.8 percent increase. The Nissan Leaf was also estimated to have lower claim frequency (-24.7 percent), and lower overall losses (-31.0 percent) than the Nissan Versa when mileage was included. Claim severity was also lower for the Nissan Leaf (-8.3 percent). All three estimates were statistically significant. The PDL claim frequency for the Tesla Model S was estimated to be 14.2 percent higher, and overall losses 32.0 percent higher than for large luxury cars. PDL claim severity, without controlling for mileage, was 15.6 percent higher. All three estimates were statistically significant.

Figure 6: Estimated property damage liability losses of electric vehicles versus conventional counterparts



A summary of the results for the studied coverage types are found in **Table 3**. Statistically significant results are bolded. This table compares the frequency and overall loss results with and without mileage as well as the uncontrolled severity estimates. Claim frequencies for the electric vehicles with gasoline powered variants and the Nissan Leaf were lower than their comparison vehicles. The reductions in claim frequencies were not as large for these vehicles once mileage was included in the model. Claim frequencies for the Tesla Model S were higher than those for the comparison vehicles. Once miles traveled was included, claim frequencies for the Tesla Model S were even higher.

Table 3: Change in insurance losses, electric versus conventional counterparts

	Claim frequency not controlling for mileage	Claim frequency controlling for mileage	Percent difference	Claim severity not controlling for mileage	Overall losses not controlling for mileage	Overall losses controlling for mileage
Collision						
Electric series	-19.3%	-14.1%	-27.2%	25.9%	1.7%	8.2%
Nissan Leaf	-13.6%	-6.8%	-49.7%	-5.8%	-18.6%	-12.2%
Tesla Model S	31.3%	36.9%	17.9%	63.5%	114.8%	123.9%
Property damage liability						
Electric series	-17.2%	-13.3%	-22.5%	8.8%	-9.9%	-5.7%
Nissan Leaf	-30.7%	-24.7%	-19.5%	-8.3%	-36.5%	-31.0%
Tesla Model S	12.0%	14.2%	18.3%	15.6%	29.4%	32.0%

Discussion

Under collision and PDL coverages, the studied electric vehicles with exact conventional counterparts had lower claim frequencies, higher claim severities, and lower overall losses than their comparison vehicles. When mileage was included in the claim frequency analysis, the magnitude of the frequency and overall loss benefits declined but remained significant. The Nissan Leaf largely followed the same patterns except it had lower claim severities. In comparison, the Tesla Model S always had higher claim frequencies, claim severities, and overall losses than large luxury cars. When mileage was considered, claim frequencies grew even larger for the Tesla. The higher claim severity for the Tesla Model S may possibly be attributed to the battery replacement cost of approximately \$16,000.

Comprehensive coverage was not included in this analysis, as miles traveled will not likely impact losses under this coverage type. Injury related coverages were also not included due to the small numbers of claims associated with the electric vehicles.

References

Highway Loss Data Institute. 2015. Insurance losses – comparison of electric vehicles and their conventional counterparts. *Loss bulletin* Vol. 32, No. 19. Arlington, VA.

► Appendix

Appendix: Illustrative regression results - collision frequency

Parameter	Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value	
Intercept	1	-8.4133		0.0214	-8.4552	-8.3714	154788.00	<0.0001	
Engine	Electric	-0.2143	-19.3%	0.0417	-0.2961	-0.1326	26.42	<0.0001	
	Conventional	0	0	0	0	0			
Vehicle model year and series	2011 BMW 1 series	1	0.1066	11.2%	0.0323	0.0433	0.1699	10.88	0.001
	2013 Fiat 500 2dr	1	-0.0669	-6.5%	0.0219	-0.1098	-0.0240	9.34	0.0022
	2014 Fiat 500 2dr	1	0.0019	0.2%	0.0636	-0.1228	0.1265	0.00	0.9767
	2015 Fiat 500 2dr	1	0.1675	18.2%	0.1113	-0.0506	0.3856	2.27	0.1322
	2011 Smart ForTwo 2dr	1	-0.2133	-19.2%	0.0583	-0.3275	-0.0991	13.40	0.0003
	2013 Smart ForTwo 2dr	1	-0.2442	-21.7%	0.0379	-0.3185	-0.1700	41.57	<0.0001
	2014 Smart ForTwo 2dr	1	-0.2106	-19.0%	0.0943	-0.3955	-0.0257	4.99	0.0256
	2015 Smart ForTwo 2dr	1	-0.2383	-21.2%	0.2505	-0.7293	0.2527	0.90	0.3415
	2013 Smart ForTwo convertible	1	-0.3050	-26.3%	0.1169	-0.5342	-0.0759	6.81	0.0091
	2014 Smart ForTwo convertible	1	0.3161	37.2%	0.2509	-0.1758	0.8079	1.59	0.2078
	2015 Smart ForTwo convertible	1	-9.1530	-100.0%	146.0920	-295.4880	277.1820	0.00	0.9500
	2012 Toyota RAV4 4dr 2WD	1	0.0734	7.6%	0.0152	0.0436	0.1032	23.30	<0.0001
	2013 Toyota RAV4 4dr 2WD	1	0.0170	1.7%	0.0246	-0.0312	0.0652	0.48	0.4897
	2014 Toyota RAV4 4dr 2WD	1	-0.0648	-6.3%	0.0173	-0.0987	-0.0309	14.01	0.0002
	2014 Chevrolet Spark 5dr	1	0.2002	22.2%	0.0288	0.1437	0.2568	48.20	<0.0001
	2015 Chevrolet Spark 5dr	1	0.0538	5.5%	0.3539	-0.6399	0.7474	0.02	0.8793
	2013 Ford Focus 5dr	1	0.0551	5.7%	0.0144	0.0269	0.0833	14.66	0.0001
	2014 Ford Focus 5dr	1	0.0601	6.2%	0.0201	0.0207	0.0996	8.91	0.0028
	2015 Ford Focus 5dr	1	-9.0473	-100.00%	74.4328	-154.933	136.8383	0.01	0.9033
	2012 Ford Focus 5dr	0	0	0	0	0	0		
Miles driven per day	Unknown	1	-0.3128	-26.9%	0.0311	-0.3739	-0.2518	100.88	<0.0001
	<10	1	-0.1320	-12.4%	0.0354	-0.2013	-0.0627	13.93	0.0002
	10–19.9	1	-0.0818	-7.9%	0.0216	-0.1240	-0.0395	14.37	0.0002
	30–39.9	1	0.0471	4.8%	0.0138	0.0201	0.0741	11.69	0.0006
	40–49.9	1	0.0767	8.0%	0.0158	0.0456	0.1077	23.40	<0.0001
	50–59.9	1	0.1445	15.5%	0.0211	0.1031	0.1860	46.71	<0.0001
	60–79.9	1	0.1865	20.5%	0.0263	0.1349	0.2381	50.23	<0.0001
	80–99.9	1	0.3265	38.6%	0.0508	0.2270	0.4260	41.38	<0.0001
	100+	1	0.4279	53.4%	0.0681	0.2943	0.5614	39.43	<0.0001
	20-29	0	0	0	0	0	0		
Rated driver age group	<20	1	0.5569	74.5%	0.0293	0.4995	0.6144	361.21	<0.0001
	20–24	1	0.3886	47.50%	0.0196	0.3501	0.4270	392.44	<0.0001
	25–29	1	0.1867	20.5%	0.0182	0.1509	0.2224	104.77	<0.0001
	30–39	1	0.0898	9.4%	0.0159	0.0587	0.1209	32.01	<0.0001
	40–49	1	0.0604	6.20%	0.0154	0.0302	0.0907	15.36	<0.0001
	60–64	1	-0.0226	-2.2%	0.0201	-0.0620	0.0167	1.27	0.2590
	65–69	1	0.0165	1.70%	0.0221	-0.0269	0.0598	0.56	0.4561
	70–74	1	0.0972	10.2%	0.0259	0.0465	0.1480	14.09	0.0002
	75+	1	0.2443	27.7%	0.0252	0.1948	0.2938	93.62	<0.0001
	Unknown	1	0.1375	14.7%	0.0238	0.0909	0.1842	33.42	<0.0001
	50–59	0	0	0	0	0	0		

Appendix: Illustrative regression results - collision frequency

Parameter	Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value	
Rated driver gender	Male	1	-0.0422	-4.1%	0.0107	-0.0633	-0.0212	15.45	<0.0001
	Unknown	1	-0.2218	-19.9%	0.0342	-0.2889	-0.1547	41.96	<0.0001
	Female	0	0	0	0	0	0		
Rated driver marital status	Single	1	0.1650	17.9%	0.0117	0.1420	0.1880	197.60	<0.0001
	Unknown	1	0.1879	20.7%	0.0338	0.1216	0.2541	30.88	<0.0001
	Married	0	0	0	0	0	0		
Risk	Nonstandard	1	0.1823	20.0%	0.0174	0.1481	0.2165	109.21	<0.0001
	Standard	0	0	0	0	0	0		
Deductible range	<101	1	0.0748	7.8%	0.0204	0.0349	0.1148	13.46	0.0002
	101–250	1	0.2585	29.5%	0.0130	0.2331	0.2840	395.49	<0.0001
	501+	1	-0.2749	-24.0%	0.0141	-0.3024	-0.2473	381.86	<0.0001
	251–500	0	0	0	0	0	0		
Registered vehicle density	<50	1	-0.3211	-27.5%	0.0231	-0.3663	-0.2759	193.83	<0.0001
	50–99	1	-0.2842	-24.7%	0.0198	-0.3230	-0.2454	206.37	<0.0001
	100–249	1	-0.2456	-21.8%	0.0157	-0.2764	-0.2147	243.69	<0.0001
	250–499	1	-0.1943	-17.7%	0.0151	-0.2238	-0.1647	166.35	<0.0001
	500–999	1	-0.1212	-11.4%	0.0137	-0.1481	-0.0944	78.39	<0.0001
	1,000+	0	0	0	0	0	0		
State	Alaska	1	0.0028	0.3%	0.1285	-0.2489	0.2546	0.00	0.9824
	Alabama	1	-0.1131	-10.7%	0.0420	-0.1954	-0.0308	7.25	0.0071
	Arkansas	1	-0.0837	-8.0%	0.0573	-0.1959	0.0286	2.13	0.1441
	Arizona	1	-0.1664	-15.3%	0.0329	-0.2308	-0.1020	25.64	<0.0001
	Colorado	1	-0.0621	-6.0%	0.0427	-0.1457	0.0216	2.12	0.1458
	Connecticut	1	-0.2776	-24.2%	0.0567	-0.3887	-0.1664	23.96	<0.0001
	District of Columbia	1	-0.0243	-2.4%	0.0885	-0.1978	0.1492	0.08	0.7837
	Delaware	1	-0.1502	-13.9%	0.0820	-0.3108	0.0105	3.36	0.0669
	Florida	1	-0.3402	-28.8%	0.0197	-0.3788	-0.3016	298.02	<0.0001
	Georgia	1	-0.2321	-20.7%	0.0274	-0.2858	-0.1784	71.66	<0.0001
	Hawaii	1	-0.0703	-6.8%	0.0563	-0.1807	0.0401	1.56	0.2122
	Iowa	1	-0.2624	-23.1%	0.0650	-0.3899	-0.1350	16.28	<0.0001
	Idaho	1	-0.5572	-42.7%	0.1050	-0.7629	-0.3514	28.18	<0.0001
	Illinois	1	-0.2156	-19.4%	0.0267	-0.2680	-0.1633	65.22	<0.0001
	Indiana	1	-0.2224	-19.9%	0.0415	-0.3038	-0.1409	28.64	<0.0001
	Kansas	1	-0.1854	-16.9%	0.0508	-0.2850	-0.0858	13.32	0.0003
	Kentucky	1	-0.3564	-30.0%	0.0463	-0.4471	-0.2656	59.28	<0.0001
	Louisiana	1	-0.0058	-0.6%	0.0392	-0.0826	0.0709	0.02	0.8816
	Massachusetts	1	-0.3349	-28.5%	0.0511	-0.4351	-0.2347	42.91	<0.0001
	Maryland	1	-0.1514	-14.0%	0.0316	-0.2134	-0.0894	22.92	<0.0001
	Maine	1	-0.1765	-16.2%	0.0894	-0.3517	-0.0013	3.90	0.0483
	Michigan	1	0.0343	3.5%	0.0244	-0.0136	0.0821	1.97	0.1603
	Minnesota	1	-0.2843	-24.7%	0.0410	-0.3647	-0.2039	48.05	<0.0001
Missouri	1	-0.2452	-21.7%	0.0374	-0.3185	-0.1720	43.07	<0.0001	
Mississippi	1	-0.0924	-8.8%	0.0654	-0.2206	0.0359	1.99	0.1581	

Appendix: Illustrative regression results - collision frequency

Parameter	Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
Montana	1	-0.2146	-19.3%	0.1540	-0.5164	0.0872	1.94	0.1635
North Carolina	1	-0.4237	-34.5%	0.0303	-0.4831	-0.3644	195.60	<0.0001
North Dakota	1	0.3654	44.1%	0.1363	0.0982	0.6326	7.18	0.0074
Nebraska	1	-0.2831	-24.7%	0.0877	-0.4550	-0.1112	10.42	0.0012
New Hampshire	1	-0.0502	-4.9%	0.0681	-0.1836	0.0832	0.54	0.4609
New Jersey	1	-0.1677	-15.4%	0.0329	-0.2322	-0.1032	25.97	<0.0001
New Mexico	1	-0.1510	-14.0%	0.0617	-0.2720	-0.0300	5.98	0.0145
Nevada	1	-0.1172	-11.1%	0.0506	-0.2163	-0.0181	5.38	0.0204
New York	1	-0.0683	-6.6%	0.0259	-0.1190	-0.0177	6.98	0.0082
Ohio	1	-0.3706	-31.0%	0.0293	-0.4280	-0.3131	159.93	<0.0001
Oklahoma	1	-0.2605	-22.9%	0.0496	-0.3576	-0.1634	27.63	<0.0001
Oregon	1	-0.3325	-28.3%	0.0508	-0.4320	-0.2330	42.92	<0.0001
Pennsylvania	1	-0.0645	-6.2%	0.0257	-0.1148	-0.0142	6.31	0.0120
Rhode Island	1	-0.1097	-10.4%	0.0958	-0.2975	0.0781	1.31	0.2523
South Carolina	1	-0.4069	-33.4%	0.0417	-0.4887	-0.3251	95.15	<0.0001
South Dakota	1	-0.2843	-24.7%	0.1426	-0.5638	-0.0048	3.97	0.0462
Tennessee	1	-0.1560	-14.4%	0.0350	-0.2246	-0.0874	19.88	<0.0001
Texas	1	-0.1506	-14.0%	0.0180	-0.1858	-0.1154	70.27	<0.0001
Utah	1	-0.3483	-29.4%	0.0763	-0.4978	-0.1988	20.86	<0.0001
Virginia	1	-0.2144	-19.3%	0.0279	-0.2692	-0.1597	58.91	<0.0001
Vermont	1	0.0699	7.2%	0.0989	-0.1240	0.2638	0.5	0.4798
Washington	1	-0.1632	-15.1%	0.0357	-0.2332	-0.0932	20.89	<0.0001
Wisconsin	1	-0.3101	-26.7%	0.0422	-0.3927	-0.2274	54.07	<0.0001
West Virginia	1	-0.1928	-17.5%	0.0699	-0.3298	-0.0559	7.61	0.0058
Wyoming	1	0.2369	26.7%	0.1581	-0.0729	0.5468	2.25	0.1340
California	0	0	0	0	0	0		
Calendar year								
2010	1	0.0073	0.7%	0.1410	-0.2690	0.2836	0	0.9586
2011	1	-0.0844	-8.1%	0.0343	-0.1517	-0.0171	6.04	0.0140
2012	1	-0.0369	-3.6%	0.0159	-0.0680	-0.0057	5.39	0.0202
2013	1	-0.0238	-2.4%	0.0108	-0.0450	-0.0026	4.85	0.0277
2014	0	0	0	0	0	0		



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