

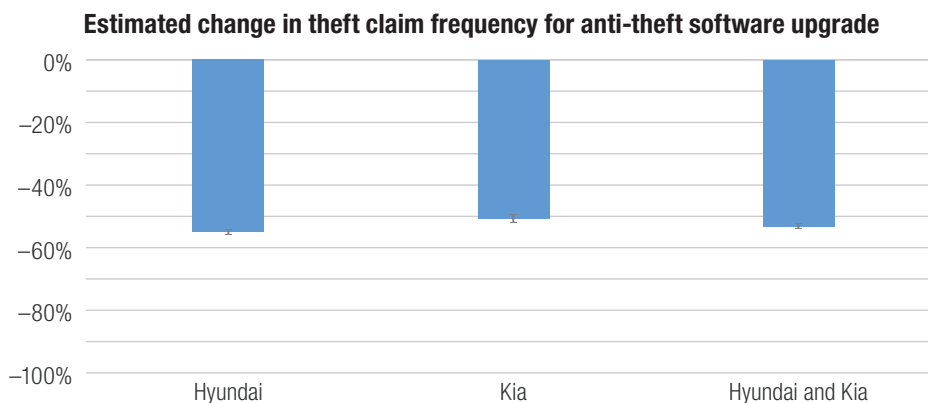


## Reductions in Hyundai and Kia comprehensive losses associated with the anti-theft software upgrade

Primary analyst: Di Huang

The increase in theft claim frequency for Hyundai and Kia vehicles, which affected older series without standard passive immobilizers in particular, has been noted since 2021. This escalation is attributed partly to the accessibility of instructional theft videos on social media platforms. Over time, this issue has expanded to include more model years and states, and vandalism claim frequency has risen as well. In response, Hyundai and Kia began implementing a software upgrade starting in February 2023 to enhance vehicle security features and deter theft attempts. As part of this effort, Hyundai and Kia collaborated with the Highway Loss Data Institute, providing the Vehicle Identification Numbers of the vehicles eligible for the software upgrade as well as information about whether or not they received it.

Initial findings showed significant reductions in theft claim frequency for upgraded Hyundai and Kia vehicles compared with those without the upgrade. As shown in the figure, theft claim frequency for Hyundai vehicles that have been upgraded was 55% lower than the vehicles that have not. Upgraded Kia vehicles also showed a significant 51% reduction in theft claim frequency compared with those that did not receive the software upgrade. When combined, Hyundai–Kia vehicles that have been upgraded exhibited a significant 53% decrease in theft claim frequency compared with the vehicles that have not been upgraded.



The anti-theft software upgrade also contributed to reductions in whole vehicle theft claim frequency. However, vandalism claim frequency increased for Hyundai–Kia vehicles that have been upgraded, likely due to failed theft attempts.

## ► Introduction

Hyundai and Kia have lagged behind other manufacturers in installing passive immobilizer anti-theft devices as standard equipment on their vehicles. Passive immobilizers were standard equipment on only 26% of 2015 Hyundai and Kia vehicle series, compared with 96% of vehicle series for all other manufacturers combined (HLDI, 2021). The lack of immobilizers has made many Hyundai and Kia vehicles easier targets for thieves, leading to a rise in theft claim frequencies for these models.

The Highway Loss Data Institute (HLDI) initially reported an increase in theft claim frequencies for Hyundai and Kia models in December 2021 (HLDI, 2021). Subsequent studies were expanded to include a wider range of model years, all states, and vandalism claims (HLDI, 2022; 2023 a-c; 2024a). These studies showed a continued escalation in theft claim frequencies for Hyundai–Kia vehicles from 2021 onwards, with the trend spreading to more states and model years and later driving up vandalism claim frequency.

To address the problem, Hyundai and Kia introduced a software upgrade for some affected vehicles. According to Hyundai and Kia, after the upgrade, vehicles will start only if a key is in the ignition. When exiting the vehicles, drivers must lock the doors with the key fob to set the factory alarm and activate the ignition “kill” feature. The ignition “kill” feature remains active even after the alarm stops sounding. Upgraded vehicles will receive a window sticker in an effort to deter potential thieves. The software upgrade has been available to selected vehicle series since February 2023.

The purpose of this bulletin is to evaluate the effectiveness of the anti-theft software upgrade by analyzing the frequencies of theft claims of all kinds, whole vehicle theft claims, and vandalism claims for Hyundai and Kia vehicles.

## ► Method

### Insurance data

Automobile insurance covers damage to vehicles and property from crashes and other events, as well as injuries to people involved in crashes. Vehicle damage and injuries are paid for by different types of insurance coverage, and different coverages may apply depending on who is at fault. The current study is based on comprehensive coverage. Comprehensive coverage insures against theft and physical damage to the insured vehicle that occurs for reasons other than crashes. Vehicle theft and vandalism losses are paid under comprehensive coverage.

Theft claims in the HLDI database can result from three different types of thefts: theft of contents from a vehicle, theft of vehicle parts, and theft of the entire vehicle. Most companies do not supply data to HLDI about the type of theft. However, using a defined methodology, HLDI is able to classify whole vehicle theft losses.

Presumably, the cost of a claim for theft of vehicle contents and/or personal valuables in a vehicle should be less than the value of the vehicle, while the theft of an entire vehicle should result in a claim that is near the residual value of the vehicle. Therefore, any theft claim that is near the residual value of the vehicle is likely to be a whole vehicle theft. Under collision coverage, a vehicle is declared a total loss when crash damage is so severe that the cost to repair the vehicle is higher than the vehicle’s residual value. Insurers then take possession of the damaged vehicle and pay the insured the residual value of the vehicle. Data on collision total loss claims are provided to HLDI. Under comprehensive coverage, when an insured vehicle is stolen, insurers pay the policy holder the residual value of the vehicle. Therefore, it can be assumed that total loss payments under collision coverage are approximately equal to payments for whole vehicle theft under comprehensive coverage. This approach enables HLDI to identify whole vehicle theft losses based on vehicle age and price (HLDI, 2024b).

### Insurance measures

Claim frequency is defined as the number of claims for a group of vehicles divided by the exposure for that group, expressed as claims per 1,000 insured vehicle years. Exposure is the length of time a vehicle is insured under a given coverage type and is measured in insured vehicle years. One insured vehicle year is one vehicle insured for 1 year, two vehicles insured for 6 months, and so forth. This study is based on theft, whole vehicle theft and vandalism claim frequencies.

## Subject vehicles

Hyundai and Kia have provided HLDI with the Vehicle Identification Numbers (VINs) of the vehicles eligible for the anti-theft software upgrade along with details indicating whether or not they received it and when, if applicable. This study focuses on the VINs provided by Hyundai and Kia that are eligible to receive an anti-theft software upgrade from model years 2011 to 2022. **Tables 1 and 2** list the vehicle series and model years of the upgradable VINs from Hyundai and Kia:

Table 1: Vehicle series of Hyundai VINs		
Make Name	Series Name	Model years
Hyundai	Accent 4dr	2018–22
	Elantra 4dr	2011–22
	Elantra GT 4dr	2013–20
	Genesis 2dr	2013–14
	Kona 4dr	2018–22
	Palisade 4dr	2020–21
	Santa Fe 4dr	2013–22
	Santa Fe Sport 4dr	2013–18
	Santa Fe XL 4dr	2019
	Sonata 4dr	2011–19
	Tucson 4dr	2011–22
	Veloster 3dr	2012–17, 2019–21
	Veloster Turbo 3dr	2014–17
	Venue 4dr	2020–21

Table 2: Vehicle series of Kia VINs		
Make Name	Series Name	Model years
Kia	Forte 2dr	2014–16
	Forte 4dr	2014–21
	Forte station wagon	2014–18
	Rio 4dr	2012–21
	Rio station wagon	2012–21
	K5 4dr	2021–22
	Optima 4dr	2011–20
	Sedona	2011–12, 2014–21
	Seltos 4dr	2021
	Seltos 4dr 4WD	2021–22
	Sorento 4dr	2011–22
	Soul station wagon	2020–22
	Sportage 4dr	2011–22
	Venue 4dr	2020–21

## Statistical methods

Regression analysis was used to quantify the differences between vehicles that received the anti-theft software upgrade and those that did not, while also controlling for other covariates. Covariates included model year, vehicle make, and vehicle series; garaging state; vehicle density (number of registered vehicles per square mile); rated driver age, gender, and marital status; comprehensive deductible and risk. Hyundai and Kia announced the initiation of the software upgrade in February 2023 (some Kia vehicles were upgraded in January 2023); thus, the comparison was limited to calendar year 2023, with the month being controlled for in this analysis.

Claims and exposure for vehicles were separated based on whether they had received the anti-theft software upgrade or not. Claims and exposure occurring after the anti-theft software upgrade were categorized as upgraded. For example, if a VIN received the software upgrade in February 2023, the exposure and claims after February would be considered as upgraded. It's worth noting that not every upgraded VIN from Hyundai and Kia aligns with available policy data in the HLDI loss data for the corresponding year and month. For example, if a VIN is reported as upgraded by Hyundai in May 2023, but its policy data in our HLDI records only extends until March 2023, then this vehicle's exposure and claims would be treated as if it hasn't been upgraded in the current analysis.

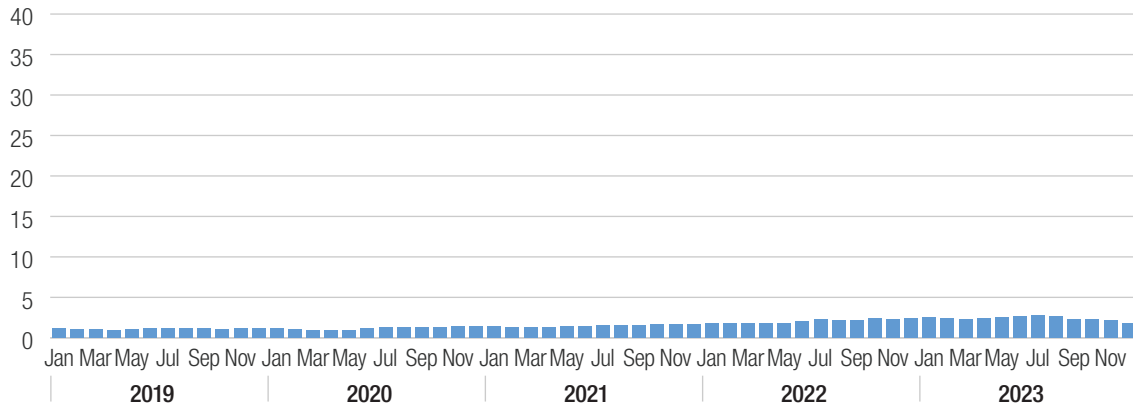
Claim frequency was modeled using a Poisson distribution. Estimates for theft claim frequency, whole vehicle theft claim frequency, and vandalism claim frequency are presented in this bulletin. To illustrate the analysis, the **Appendix** contains full model results for theft claim frequency of Hyundai vehicles. To further simplify the presentation, the exponent of the parameter estimate was calculated, 1 was subtracted, and the result multiplied by 100. For example, the estimate of the difference in theft claim frequency between the VINs that received the anti-theft software upgrade and those that did not was  $-0.7984$  for Hyundai; thus, the theft claim frequency of vehicles with the anti-theft software upgrade was 55% lower than vehicles without the upgrade ( $[\exp(-0.7984) - 1] \times 100 = -55$ ).

## ► Results

### Theft claim frequency

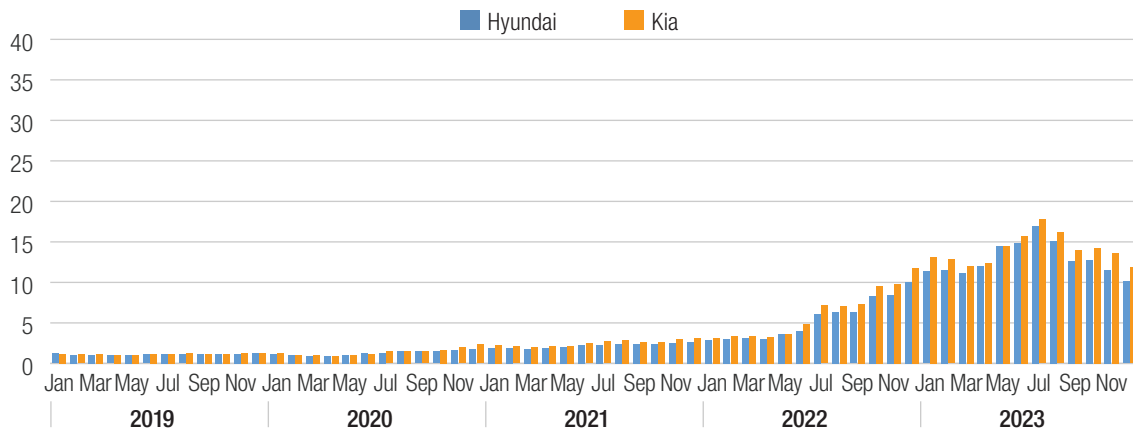
**Figure 1** shows the theft claim frequency by month for vehicles across all manufacturers for model years 2011–22. From January 2019 to December 2023, the national trend remained relatively stable, with an average theft claim frequency of less than 3 claims per 1,000 insured vehicle years for all months.

**Figure 1: All manufacturer theft claim frequency, model years 2011–22**



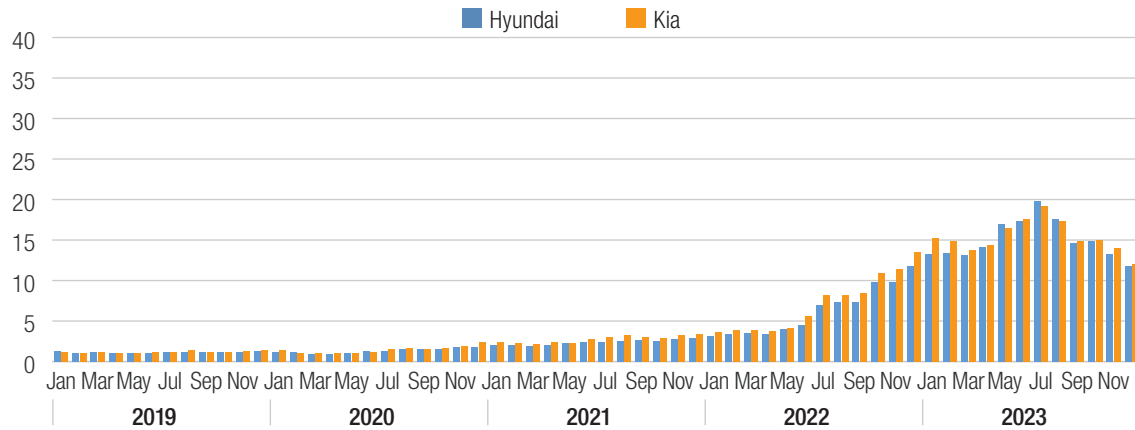
**Figure 2** shows the theft claim frequency by month for all Hyundai and Kia series for model years 2011–22. Before 2020, theft claim frequency for Hyundai and Kia vehicles closely approximated the national average. However, from mid-2020 onward, the theft claim frequency for these vehicles was consistently higher than the national average, despite a downward trend observed after July 2023. By December 2023, the theft claim frequency stood at 10 claims per 1,000 insured vehicle years for Hyundai and 12 claims for Kia.

**Figure 2: Hyundai and Kia theft claim frequency, model years 2011–22**



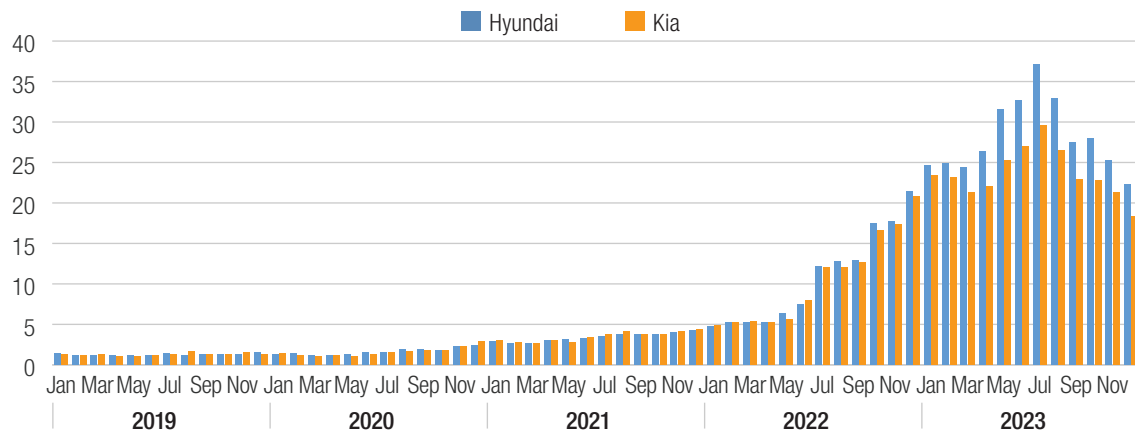
Narrowing focus further to selected Hyundai and Kia vehicle series eligible for the anti-theft software upgrade, **Figure 3** illustrates the theft claim frequency by month for selected Hyundai and Kia vehicle series for model years 2011–22. The theft claim frequencies of these upgradable series were slightly higher than those of all Hyundai and Kia series (**Figure 2**), indicating the heightened vulnerability to theft for these specific affected series.

**Figure 3: Upgradable Hyundai and Kia series theft claim frequency, model years 2011–22**



**Figure 4** narrows the trend to the VINs provided by Hyundai and Kia that were identified as being at the highest risk of theft. As shown in the figure, these upgradable VINs exhibit extremely high theft claim frequencies, in some instances exceeding 35 claims per 1,000 insured vehicle years.

**Figure 4: Upgradable Hyundai and Kia VINs theft claim frequency, model years 2011–22**

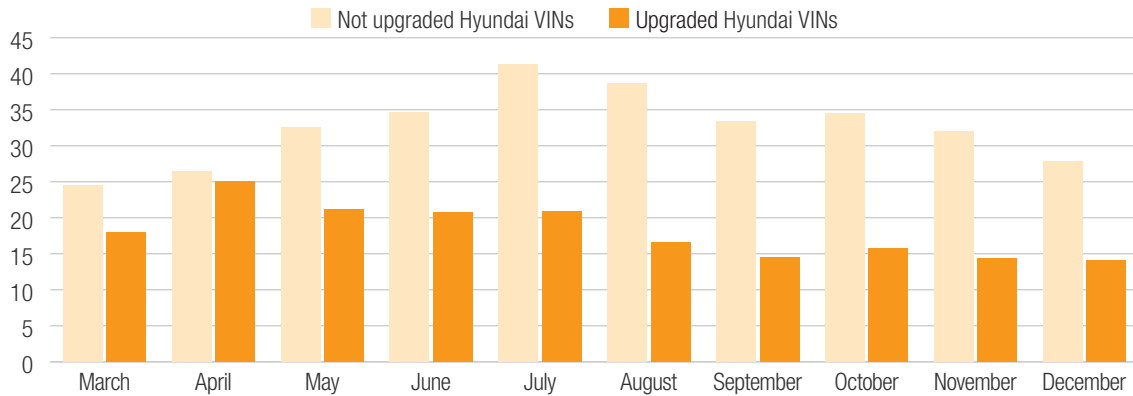


**Figures 1–4** collectively displayed the heightened theft risk associated with Hyundai and Kia vehicles, especially those VINs provided by Hyundai and Kia.

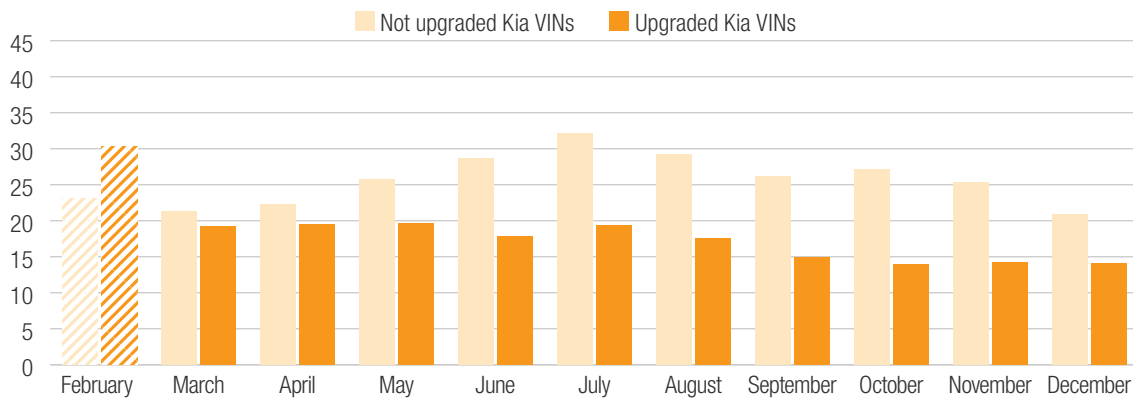
**Figures 5–7** examine the impact of the anti-theft software upgrade on theft using VINs provided by Hyundai and Kia as the study population. Since the anti-theft software upgrade began in February 2023 for both Hyundai and Kia, only calendar year 2023 was included in this analysis.

**Figure 5** shows the theft claim frequencies for Hyundai VINs that received the software upgrade versus those that did not for each month in 2023. Hyundai VINs that have been upgraded consistently exhibited lower theft claim frequencies compared with the VINs that have not been upgraded, with a declining trend observed over time. In December 2023, the average theft claim frequency was 14 claims per 1,000 insured vehicle years for the upgraded Hyundai VINs, compared with 28 claims for the non-upgraded VINs. The theft claim frequency for upgraded Kia VINs was also lower than the non-upgraded Kia VINs in each month (**Figure 6**), except for February. This is likely due to the limited data available in February because only a few Kia vehicles were upgraded in January.

**Figure 5: Hyundai theft claim frequency by month, calendar year 2023**

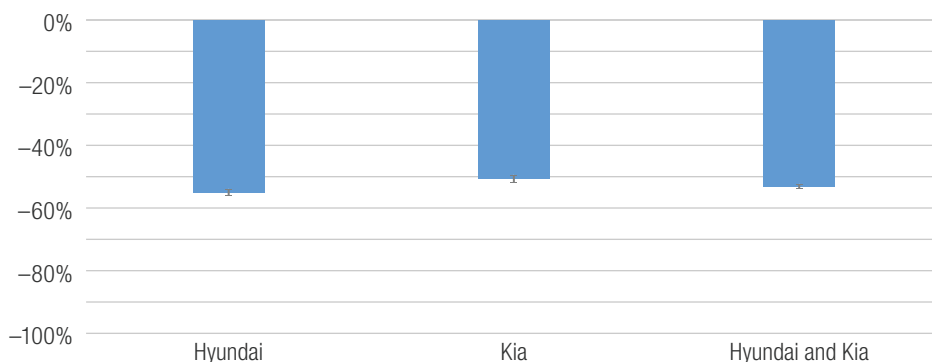


**Figure 6: Kia theft claim frequency by month, calendar year 2023**



**Figure 7** shows the estimated differences in theft claim frequency for upgraded and non-upgraded VINs from Hyundai, Kia, and Hyundai-Kia combined. The theft claim frequency decreased significantly by 55% for Hyundai vehicles that have been upgraded compared with those that have not. Similarly, Kia exhibited a significant 51% reduction for vehicles that have received the software upgrade. When combined, Hyundai-Kia vehicles that have been upgraded showed a significant 53% decrease in theft claim frequency compared with those that have not been upgraded.

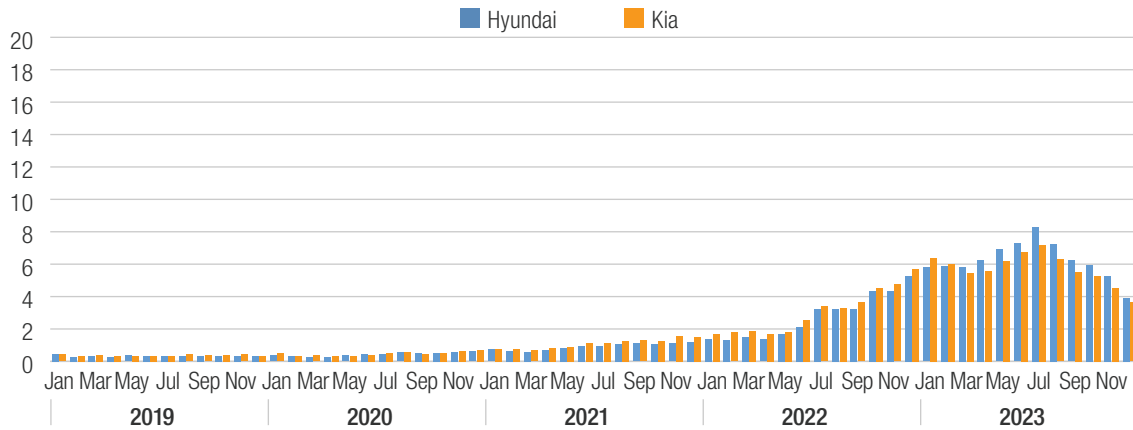
**Figure 7: Estimated change in theft claim frequency for anti-theft software upgrade**



## Whole vehicle theft claim frequency

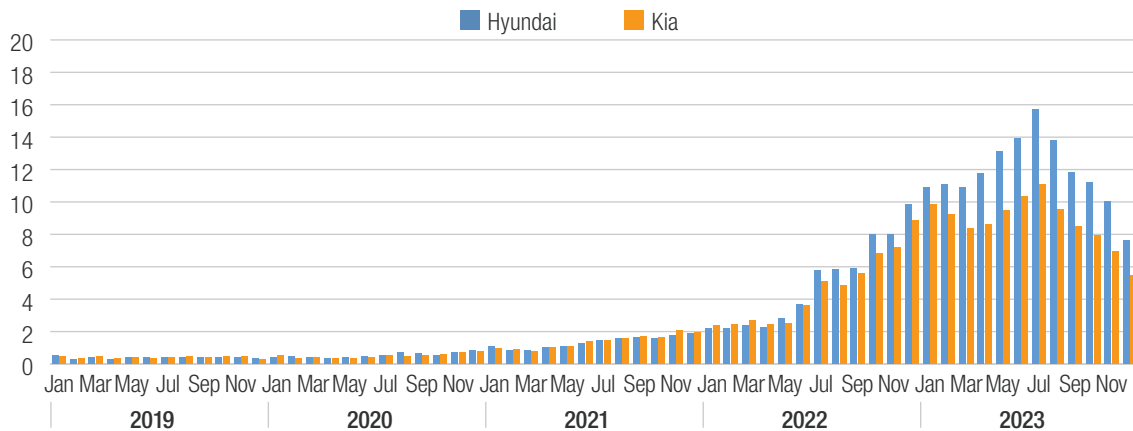
**Figure 8** illustrates the monthly whole vehicle theft claim frequency for selected Hyundai and Kia vehicles eligible for the anti-theft software upgrade, spanning model years 2011–22. Whole vehicle theft claim frequency started to rise in 2021 and continued to increase throughout 2022 and the first half of 2023, though it declined during the second half of 2023.

**Figure 8: Upgradable Hyundai and Kia series whole vehicle theft claim frequency, model years 2011–22**



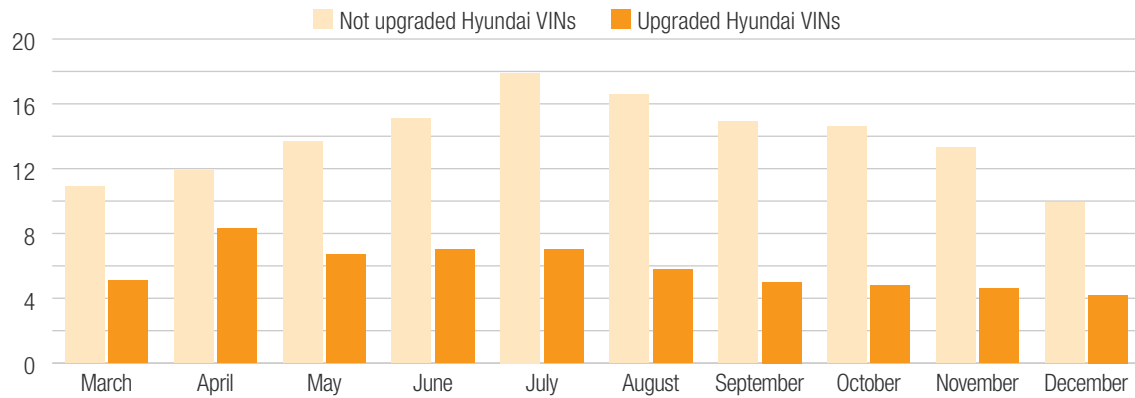
**Figure 9** illustrates the monthly whole vehicle theft claim frequency for upgradable VINs provided by Hyundai and Kia for model years 2011–22. The trend observed for these vehicles paralleled that of the upgradable Hyundai and Kia vehicles series (**Figure 8**), but with a higher frequency of whole vehicle theft claims.

**Figure 9: Upgradable Hyundai and Kia VINs whole vehicle theft claim frequency, model years 2011–22**



Figures 10 and 11 delve into the impact of the anti-theft software upgrade on whole vehicle theft. Similarly, the analysis utilized VINs provided by Hyundai and Kia as the study population. The trends for both Hyundai and Kia vehicles are similar to those of theft, but with more pronounced differences between the upgraded and non-upgraded VINs. Upgraded Hyundai VINs consistently exhibited lower whole vehicle theft claim frequencies compared with the non-upgraded counterparts in 2023. The whole vehicle theft claim frequency of Kia upgraded VINs was also lower than the non-upgraded Kia VINs in each month except for February 2023.

**Figure 10: Hyundai whole vehicle theft claim frequency by month, calendar year 2023**



**Figure 11: Kia whole vehicle theft claim frequency by month, calendar year 2023**

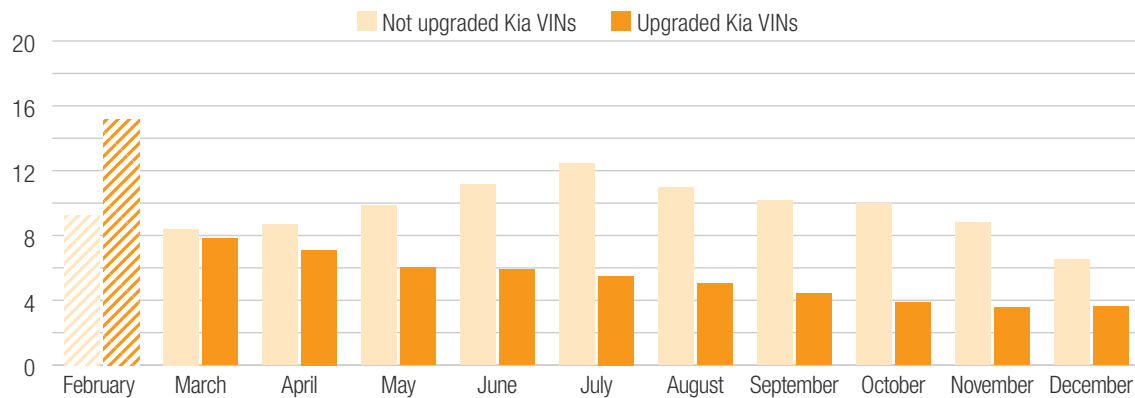
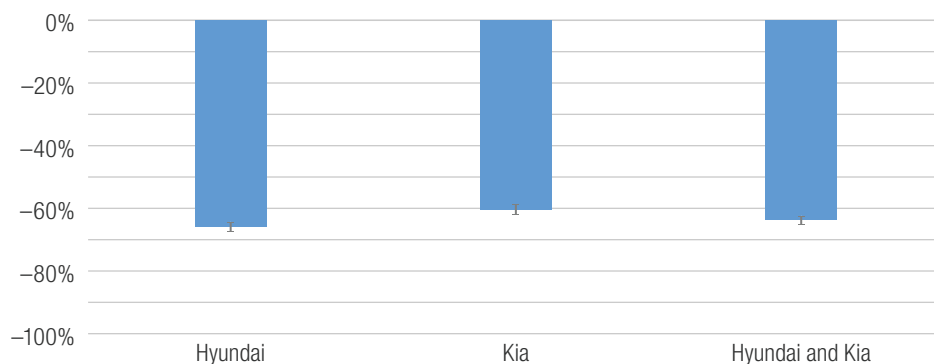


Figure 12 shows the estimated differences in whole vehicle theft claim frequency of upgraded and non-upgraded VINs for Hyundai, Kia, and Hyundai-Kia combined. The whole theft claim frequency decreased significantly by 66% and 61% for upgraded Hyundai and Kia vehicles, respectively. When combined, upgraded Hyundai-Kia vehicles showed a significant 64% reduction in whole vehicle theft claim frequency compared with those that did not receive the upgrade.

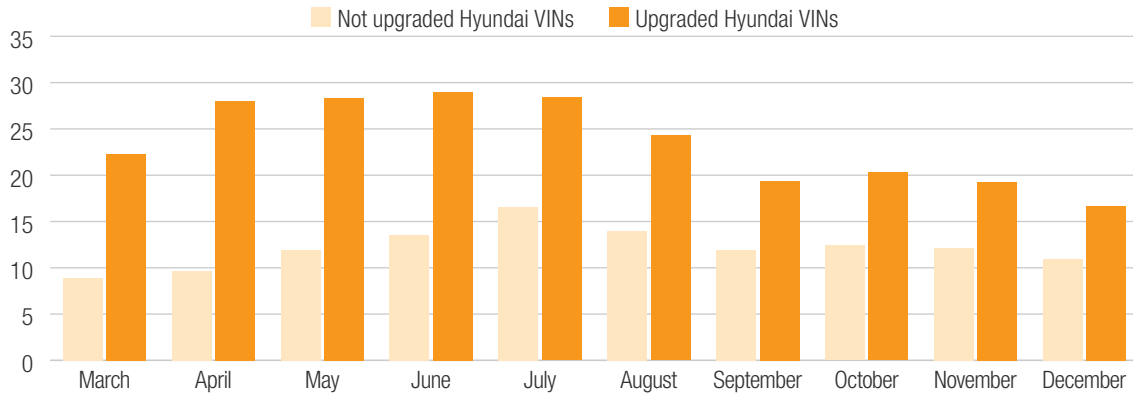
**Figure 12: Estimated change in whole vehicle theft claim frequency for anti-theft software upgrade**



## Vandalism claim frequency

Figures 13 and 14 show the monthly vandalism claim frequency for upgraded and non-upgraded Hyundai and Kia VINs in 2023. Unlike theft and whole vehicle theft, the vandalism claim frequency for VINs that have been upgraded was higher compared with VINs that have not been upgraded in each month for both Hyundai and Kia.

**Figure 13: Hyundai vandalism claim frequency by month, calendar year 2023**



**Figure 14: Kia vandalism claim frequency by month, calendar year 2023**

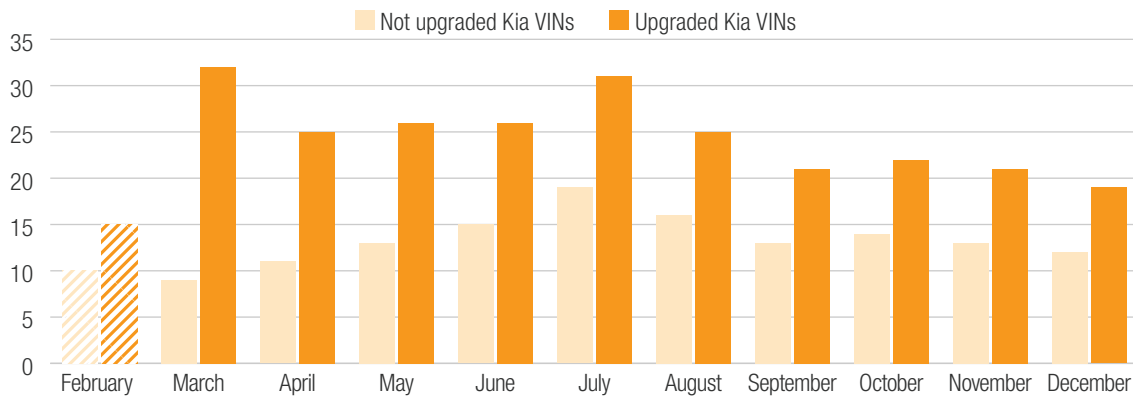
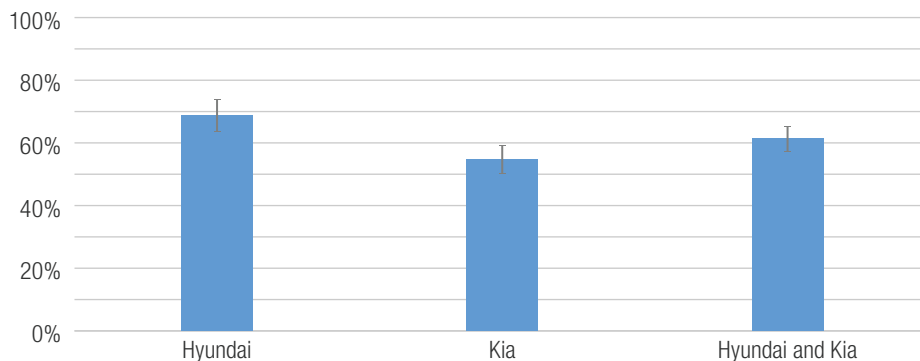


Figure 15 shows the estimated differences in vandalism claim frequency for upgraded and non-upgraded VINs of Hyundai, Kia, and Hyundai-Kia combined. The vandalism claim frequency increased significantly by 69% for Hyundai and 55% for Kia. When combined, there was a 61% increase in vandalism claim frequency for upgraded Hyundai-Kia vehicles compared with those that did not receive the upgrade.

**Figure 15: Estimated change in vandalism claim frequency for anti-theft software upgrade**



## ► Discussion

Theft claim frequencies for Hyundai and Kia vehicles were notably higher than the national average, indicating a heightened vulnerability of these vehicles to theft. Despite a declining trend observed after mid-2023, theft remained a persistent issue for Hyundai and Kia vehicles. By December 2023, the theft claim frequency of 2011–22 upgradable VINs was over 22 claims per 1,000 insured vehicle years for Hyundai and 18 claims for Kia. However, the introduction of the anti-theft software upgrade in February 2023 showed promising results.

Hyundai and Kia VINs that have been upgraded consistently showed lower theft claim frequencies compared with their counterparts that have not been upgraded. There was a significant 53% reduction in theft claim frequency for Hyundai–Kia vehicles that received the anti-theft software upgrade. The reduction in whole vehicle theft claim frequency was even more pronounced, reaching a significant 64% reduction. These findings suggest that the anti-theft software upgrade has been effective in deterring theft and protecting vehicles from being stolen. However, despite the success of the anti-theft software upgrade in reducing theft, the upgrade may have inadvertently led to an increase in vandalism incidents. Hyundai and Kia vehicles that received the software upgrade had a significant 61% increase in vandalism claim frequency compared with those that did not receive the upgrade. It appears that Hyundai and Kia vehicles are still targeted for theft, but would-be thieves are failing to steal the vehicles because they mistakenly target a vehicle that has been upgraded with the software. Consequently, a vandalism claim is filed for a broken window or other damage rather than a theft claim.

In summary, despite the positive impact of the anti-theft software upgrade, challenges persist. High theft claim frequencies for Hyundai–Kia vehicles continue, although there has been a decrease since July 2023. Additionally, there is a new concern about vandalism potentially resulting from the software upgrade.

## Upgraded population group

Hyundai and Kia have provided HLDI with the VINs of the vehicles eligible for new anti-theft software and corresponding information on whether they have received it. These VINs potentially include vehicles that have been totaled or otherwise removed from the insured vehicle fleet. Understanding the implementation dynamics of this upgrade is crucial for assessing the effectiveness of their anti-theft measures. **Table 3** presents the Hyundai and Kia VIN counts alongside their respective implementation percentages for the anti-theft software upgrade. Three distinct populations are included:

- **Upgradable series:** VIN counts of the series eligible to receive the anti-theft software upgrade in the current HLDI database.
- **Upgradable VINs:** VINs provided by Hyundai and Kia that are eligible to receive the anti-theft software upgrade that match to VINs in the current HLDI database.
- **Upgraded VINs:** Upgradable VINs that have received the software upgrade.

As of December 2023, Hyundai has deployed the anti-theft software upgrade in 30% of the upgradable VINs, which corresponds to 17% of all Hyundai upgradable series present in the HLDI database. Kia has implemented the upgrade in 28% of the upgradable VINs, representing 18% of all Kia upgradable series within the HLDI data. Both Hyundai (61%) and Kia (60%) report higher upgrade rates as of July 2024 in the United States. There are several possibilities for the differences in the upgrade rates. Firstly, 92% of the VINs sent to HLDI by Hyundai and 91% of the VINs sent by Kia were in the HLDI loss database. Secondly, the HLDI data is only through December 2023 and does not reflect any upgrades made in calendar year 2024.

**Table 3: Hyundai and Kia VIN count summary**

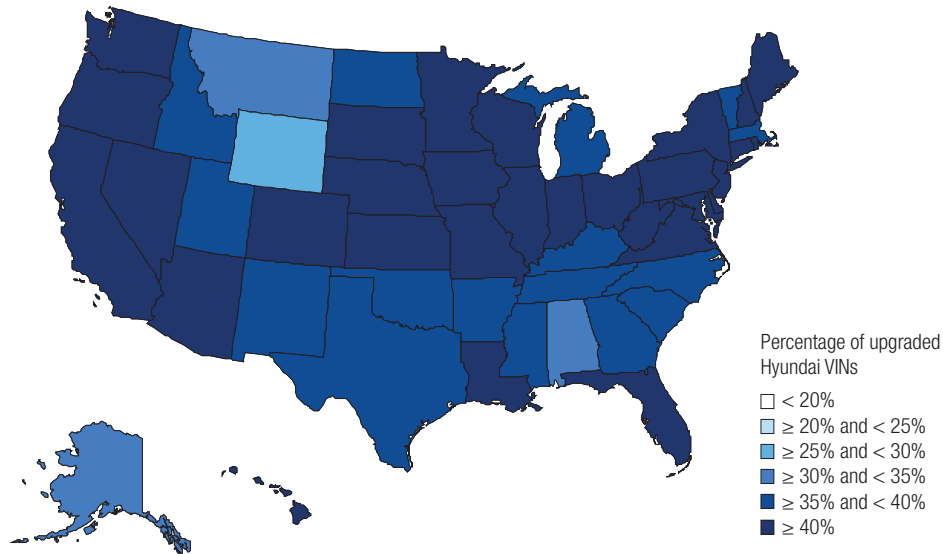
	Upgradable series	Upgradable VINs	Upgraded VINs	Percentage of upgraded VINs in upgradable VINs	Percentage of upgraded VINs in upgradable series
Hyundai	6,334,349	3,497,439	1,047,873	30%	17%
Kia	4,609,199	2,871,136	817,269	28%	18%

\* Upgraded VINs through December 2023

**Maps 1 and 2** display the upgradable VINs that have received the software upgrade by state. The maps only include upgradable VINs for which HLDI had an insurance record in December 2023, the final month of the study period. This was done to best capture the upgrade rates for vehicles likely still on the road and potentially vulnerable to theft. Not all of the upgradable VINs appear in the HLDI data in December 2023. This may be because a vehicle has been totaled and thus removed from the vehicle fleet, the owner may have dropped their comprehensive coverage, or switched insurance carriers to one that doesn't supply HLDI with loss data. It is important to note that the state shown on the maps corresponds to the garaging state of each VIN, not necessarily where the software upgrade occurred.

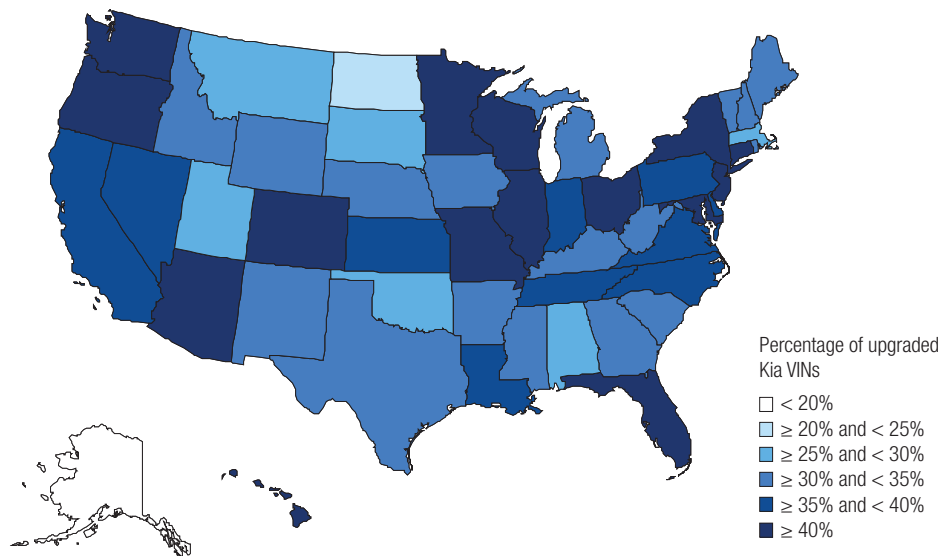
**Map 1** shows the percentage of upgraded Hyundai VINs by state. The implementation rate of the software upgrade for Hyundai ranges from 30% to 53%. Minnesota and the District of Columbia have the highest implementation rates and Wyoming has the lowest.

**Map 1: Percentage of upgraded Hyundai VINs by state**



**Map 2** shows the percentage of upgraded Kia VINs by state. The implementation rate for Kia is slightly lower than Hyundai. Colorado and the District of Columbia have the highest rollout rate of 44% and 50% respectively, while Alaska's 19% is the lowest.

**Map 2: Percentage of upgraded Kia VINs by state**



## References

- Highway Loss Data Institute. (2021). Hyundai and Kia theft losses. *Loss Bulletin*, 38(28).
- Highway Loss Data Institute. (2022). Hyundai and Kia theft losses by passive immobilizer availability. *Loss Bulletin*, 39(29).
- Highway Loss Data Institute. (2023a). Hyundai and Kia theft and vandalism losses. *Loss Bulletin*, 40(8).
- Highway Loss Data Institute. (2023b). Hyundai and Kia theft and vandalism losses. *Loss Bulletin*, 40(17).
- Highway Loss Data Institute. (2023c). Hyundai and Kia theft and vandalism losses. *Loss Bulletin*, 40(25).
- Highway Loss Data Institute. (2024a). Hyundai and Kia theft and vandalism losses. *Loss Bulletin*, 41(15).
- Highway Loss Data Institute. (2024b). Whole vehicle theft losses. Insurance report. WT-23.

► **Appendix**

Appendix: Illustrative regression results — Hyundai theft claim frequency									
Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
Intercept		1	-8.9522		0.0510	-9.0521	-8.8522	30821.70	<0.0001
State	Alabama	1	-0.5116	-40%	0.0692	-0.6473	-0.3759	54.58	<0.0001
	Alaska	1	0.2316	26%	0.2368	-0.2325	0.6957	0.96	0.3280
	Arizona	1	0.6281	87%	0.0404	0.5488	0.7073	241.22	<0.0001
	Arkansas	1	-0.4978	-39%	0.1279	-0.7484	-0.2472	15.16	<0.0001
	California	1	0.9776	166%	0.0224	0.9337	1.0215	1906.44	<0.0001
	Colorado	1	1.2130	236%	0.0346	1.1452	1.2809	1227.20	<0.0001
	Connecticut	1	0.6193	86%	0.0353	0.5501	0.6884	307.96	<0.0001
	Delaware	1	0.0224	2%	0.0796	-0.1336	0.1783	0.08	0.7788
	District of Columbia	1	2.1666	773%	0.0417	2.0848	2.2483	2696.42	<0.0001
	Florida	1	-1.2863	-72%	0.0352	-1.3553	-1.2172	1334.47	<0.0001
	Georgia	1	-0.1872	-17%	0.0346	-0.2551	-0.1194	29.23	<0.0001
	Hawaii	1	-0.9581	-62%	0.1472	-1.2465	-0.6697	42.39	<0.0001
	Idaho	1	-0.9001	-59%	0.1870	-1.2666	-0.5335	23.16	<0.0001
	Illinois	1	0.6139	85%	0.0271	0.5607	0.6670	513.02	<0.0001
	Indiana	1	-0.1433	-13%	0.0511	-0.2435	-0.0431	7.86	0.0051
	Iowa	1	-0.2001	-18%	0.0892	-0.3750	-0.0252	5.03	0.0249
	Kansas	1	0.5680	76%	0.0554	0.4594	0.6767	104.98	<0.0001
	Kentucky	1	0.1004	11%	0.0500	0.0024	0.1984	4.03	0.0446
	Louisiana	1	0.6037	83%	0.0492	0.5072	0.7001	150.54	<0.0001
	Maine	1	-1.7360	-82%	0.3023	-2.3286	-1.1434	32.97	<0.0001
	Maryland	1	1.3069	269%	0.0243	1.2593	1.3545	2896.78	<0.0001
	Massachusetts	1	-0.8792	-58%	0.0494	-0.9759	-0.7824	317.21	<0.0001
	Michigan	1	0.2702	31%	0.0570	0.1584	0.3820	22.45	<0.0001
	Minnesota	1	0.9064	148%	0.0353	0.8373	0.9755	660.49	<0.0001
	Mississippi	1	0.5878	80%	0.0744	0.4419	0.7336	62.40	<0.0001
	Missouri	1	0.8109	125%	0.0351	0.7422	0.8797	534.72	<0.0001
	Montana	1	-0.0518	-5%	0.2690	-0.5791	0.4755	0.04	0.8472
	Nebraska	1	0.9731	165%	0.0510	0.8732	1.0730	364.47	<0.0001
	Nevada	1	2.0074	644%	0.0321	1.9445	2.0703	3909.75	<0.0001
	New Hampshire	1	-1.7271	-82%	0.2592	-2.2351	-1.2191	44.40	<0.0001
	New Jersey	1	-0.3762	-31%	0.0335	-0.4418	-0.3106	126.45	<0.0001
	New Mexico	1	1.1479	215%	0.0657	1.0192	1.2766	305.54	<0.0001
	New York	1	0.2940	34%	0.0279	0.2393	0.3486	111.17	<0.0001
	North Carolina	1	0.1136	12%	0.0346	0.0458	0.1814	10.77	0.0010
	North Dakota	1	0.5996	82%	0.2021	0.2034	0.9958	8.80	0.0030
	Ohio	1	0.4269	53%	0.0290	0.3702	0.4837	217.42	<0.0001
	Oklahoma	1	-1.1466	-68%	0.0952	-1.3333	-0.9599	144.93	<0.0001
	Oregon	1	0.6416	90%	0.0512	0.5412	0.7419	157.14	<0.0001
	Pennsylvania	1	0.3552	43%	0.0282	0.2998	0.4105	158.13	<0.0001
	Rhode Island	1	-0.9932	-63%	0.1055	-1.2000	-0.7863	88.56	<0.0001
	South Carolina	1	-0.5856	-44%	0.0658	-0.7147	-0.4565	79.10	<0.0001

**Appendix: Illustrative regression results — Hyundai theft claim frequency**

Parameter	Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value	
	South Dakota	1	0.7156	105%	0.1682	0.3859	1.0454	18.09	<0.0001
	Tennessee	1	0.2811	32%	0.0398	0.2030	0.3592	49.77	<0.0001
	Utah	1	-1.4014	-75%	0.0973	-1.5922	-1.2107	207.31	<0.0001
	Vermont	1	0.0467	5%	0.2784	-0.4989	0.5924	0.03	0.8667
	Virginia	1	-0.3050	-26%	0.0359	-0.3754	-0.2345	72.06	<0.0001
	Washington	1	1.5383	366%	0.0275	1.4844	1.5922	3124.35	<0.0001
	West Virginia	1	-1.1129	-67%	0.1937	-1.4926	-0.7332	33.01	<0.0001
	Wisconsin	1	0.2670	31%	0.0524	0.1642	0.3697	25.93	<0.0001
	Wyoming	1	0.2278	26%	0.3176	-0.3946	0.8503	0.51	0.4731
	Texas	0	0	0	0	0	0	0	0
<b>Risk</b>	Nonstandard	1	-0.0996	-9%	0.0160	-0.1309	-0.0682	38.82	<0.0001
	Standard	0	0	0	0	0	0	0	0
<b>Rated driver age group</b>	14–24	1	-0.0199	-2%	0.0197	-0.0585	0.0186	1.03	0.3110
	25–29	1	0.1766	19%	0.0173	0.1426	0.2106	103.79	<0.0001
	30–39	1	0.1242	13%	0.0155	0.0939	0.1545	64.52	<0.0001
	50–59	1	-0.0644	-6%	0.0175	-0.0988	-0.0300	13.45	0.0002
	60–64	1	-0.1671	-15%	0.0223	-0.2109	-0.1233	55.98	<0.0001
	65–69	1	-0.1921	-17%	0.0239	-0.2389	-0.1453	64.66	<0.0001
	70+	1	-0.5300	-41%	0.0216	-0.5724	-0.4876	600.34	<0.0001
	Unknown	1	0.0729	8%	0.0400	-0.0055	0.1512	3.33	0.0682
	40–49	0	0	0	0	0	0	0	0
<b>Rated driver gender</b>	Female	1	0.0021	0%	0.0398	-0.0760	0.0801	0.00	0.9588
	Male	1	-0.0212	-2%	0.0400	-0.0996	0.0573	0.28	0.5973
	Unknown	0	0	0%	0	0	0	0	0
<b>Rated driver marital status</b>	Married	1	-0.2524	-22%	0.0448	-0.3401	-0.1646	31.79	<0.0001
	Single	1	0.1434	15%	0.0442	0.0568	0.2301	10.52	0.0012
	Unknown	0	0	0	0	0	0	0	0
<b>Deductible range</b>	0–250	1	-0.2624	-23%	0.0144	-0.2907	-0.2341	330.00	<0.0001
	251–500	1	-0.0384	-4%	0.0117	-0.0613	-0.0155	10.81	0.0010
	1,001+	1	-0.0231	-2%	0.0272	-0.0763	0.0302	0.72	0.3955
	501–1,000	0	0	0	0	0	0	0	0
<b>Registered vehicle density</b>	0–99	1	-1.5528	-79%	0.0229	-1.5977	-1.5079	4595.42	<0.0001
	100–499	1	-1.0003	-63%	0.0129	-1.0256	-0.9749	5976.64	<0.0001
	500+	0	0	0	0	0	0	0	0
<b>Month</b>	March	1	-0.1909	-17%	0.0227	-0.2354	-0.1464	70.72	<0.0001
	April	1	-0.0854	-8%	0.0225	-0.1295	-0.0414	14.45	0.0001
	May	1	0.1261	13%	0.0215	0.0840	0.1683	34.44	<0.0001
	June	1	0.1946	21%	0.0215	0.1525	0.2367	82.05	<0.0001
	July	1	0.3634	44%	0.0208	0.3226	0.4043	304.38	<0.0001
	August	1	0.2777	32%	0.0213	0.2359	0.3195	169.61	<0.0001
	September	1	0.1338	14%	0.0223	0.0901	0.1776	35.95	<0.0001
	October	1	0.1814	20%	0.0221	0.1381	0.2248	67.35	<0.0001
	November	1	0.1056	11%	0.0228	0.0609	0.1504	21.39	<0.0001
	December	0	0	0	0	0	0	0	0

**Appendix: Illustrative regression results — Hyundai theft claim frequency**

Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
Vehicle model year and series	2011 ELANTRA 4D	1	-0.2122	-19%	0.0415	-0.2937	-0.1308	26.10	<0.0001
	2011 TUCSON 4D 2WD	1	-1.1997	-70%	0.0852	-1.3667	-1.0326	198.16	<0.0001
	2011 TUCSON 4D 4WD	1	-1.3086	-73%	0.1211	-1.5460	-1.0712	116.72	<0.0001
	2011 SONATA 4D	1	-0.0671	-6%	0.0309	-0.1277	-0.0065	4.71	0.0299
	2012 ELANTRA 4D	1	-0.3511	-30%	0.0350	-0.4197	-0.2825	100.66	<0.0001
	2012 TUCSON 4D 2WD	1	-1.1763	-69%	0.0806	-1.3344	-1.0183	212.79	<0.0001
	2012 TUCSON 4D 2WD	1	-1.0528	-65%	0.0933	-1.2357	-0.8699	127.28	<0.0001
	2012 VELOSTER 3D	1	-1.5222	-78%	0.1427	-1.8019	-1.2424	113.75	<0.0001
	2012 SONATA 4D	1	-0.0424	-4%	0.0330	-0.1071	0.0224	1.65	0.1996
	2014 ELANTRA 4D	1	-0.3288	-28%	0.0337	-0.3948	-0.2628	95.30	<0.0001
	2014 ELANTRA GT 5D	1	-1.3820	-75%	0.1255	-1.6280	-1.1360	121.24	<0.0001
	2014 GENESIS COUPE 2D	1	-1.4333	-76%	0.4087	-2.2344	-0.6323	12.30	0.0005
	2014 SANTA FE 4D 2WD	1	-1.1887	-70%	0.2893	-1.7558	-0.6216	16.88	<0.0001
	2014 SANTA FE 4D 4WD	1	-1.1151	-67%	0.2893	-1.6822	-0.5480	14.85	0.0001
	2014 SANTA FE SPORT 4D 2WD	1	-1.8753	-85%	0.0948	-2.0611	-1.6895	391.18	<0.0001
	2014 SANTA FE SPORT 4D 4WD	1	-1.4869	-77%	0.0912	-1.6657	-1.3082	265.89	<0.0001
	2014 TUCSON 4D 2WD	1	-1.5561	-79%	0.1228	-1.7967	-1.3154	160.63	<0.0001
	2014 TUCSON 4D 4WD	1	-1.5658	-79%	0.1428	-1.8456	-1.2860	120.31	<0.0001
	2014 VELOSTER 3D	1	-1.7303	-82%	0.2050	-2.1322	-1.3285	71.23	<0.0001
	2014 VELOSTER TURBO 3D	1	-1.4921	-78%	0.5004	-2.4729	-0.5114	8.89	0.0029
	2014 SONATA 4D	1	0.0000	0%	0.0323	-0.0633	0.0632	0.00	0.9996
	2015 ELANTRA 4D	1	-0.3217	-28%	0.0315	-0.3833	-0.2600	104.55	<0.0001
	2015 ELANTRA GT 5D	1	-2.0428	-87%	0.3168	-2.6638	-1.4219	41.58	<0.0001
	2015 SANTA FE 4D 2WD	1	-1.1985	-70%	0.2893	-1.7655	-0.6314	17.16	<0.0001
	2015 SANTA FE 4D 4WD	1	-1.5082	-78%	0.2894	-2.0754	-0.9410	27.16	<0.0001
	2015 SANTA FE SPORT 4D 2WD	1	-1.0240	-64%	0.1044	-1.2287	-0.8194	96.22	<0.0001
	2015 SANTA FE SPORT 4D 4WD	1	-1.2537	-71%	0.1135	-1.4761	-1.0313	122.08	<0.0001
	2015 TUCSON 4D 2WD	1	-1.2563	-72%	0.0956	-1.4437	-1.0688	172.62	<0.0001
	2015 TUCSON 4D 4WD	1	-1.3797	-75%	0.1029	-1.5813	-1.1781	179.94	<0.0001
	2015 VELOSTER 3D	1	-1.6030	-80%	0.1806	-1.9571	-1.2490	78.75	<0.0001
	2015 VELOSTER TURBO 3D	1	-1.6513	-81%	0.5777	-2.7835	-0.5191	8.17	0.0043
	2015 SONATA 4D	1	0.2367	27%	0.0274	0.1831	0.2904	74.92	<0.0001
2016 ELANTRA 4D	1	-0.2392	-21%	0.0296	-0.2973	-0.1811	65.11	<0.0001	
2016 ELANTRA GT 5D	1	-1.2360	-71%	0.0918	-1.4160	-1.0561	181.18	<0.0001	
2016 SANTA FE 4D 2WD	1	-1.4094	-76%	0.2433	-1.8863	-0.9326	33.55	<0.0001	
2016 SANTA FE 4D 4WD	1	-1.6055	-80%	0.2191	-2.0349	-1.1761	53.70	<0.0001	
2016 SANTA FE SPORT 4D 2WD	1	-1.2526	-71%	0.1014	-1.4513	-1.0539	152.70	<0.0001	
2016 SANTA FE SPORT 4D 4WD	1	-1.2389	-71%	0.0977	-1.4304	-1.0473	160.71	<0.0001	
2016 TUCSON 4D 2WD	1	-0.1261	-12%	0.0464	-0.2171	-0.0350	7.37	0.0066	
2016 TUCSON 4D 4WD	1	-0.0117	-1%	0.0515	-0.1127	0.0893	0.05	0.8198	
2016 VELOSTER 3D	1	-1.5812	-79%	0.1219	-1.8202	-1.3422	168.16	<0.0001	
2016 VELOSTER TURBO 3D	1	-1.9014	-85%	0.3541	-2.5954	-1.2074	28.84	<0.0001	
2016 SONATA 4D	1	0.2652	30%	0.0280	0.2104	0.3200	89.92	<0.0001	
2017 ELANTRA 4D	1	0.1353	14%	0.0274	0.0816	0.1889	24.44	<0.0001	

**Appendix: Illustrative regression results — Hyundai theft claim frequency**

Parameter	Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
2017 ELANTRA GT 5D	1	-1.2319	-71%	0.1228	-1.4726	-0.9913	100.68	<0.0001
2017 SANTA FE 4D 2WD	1	-1.3620	-74%	0.1350	-1.6266	-1.0973	101.73	<0.0001
2017 SANTA FE 4D 4WD	1	-1.7421	-82%	0.1520	-2.0400	-1.4442	131.35	<0.0001
2017 SANTA FE SPORT 4D 2WD	1	-1.1886	-70%	0.0694	-1.3246	-1.0525	293.15	<0.0001
2017 SANTA FE SPORT 4D 4WD	1	-1.2333	-71%	0.0673	-1.3651	-1.1015	336.28	<0.0001
2017 TUCSON 4D 2WD	1	-0.0496	-5%	0.0401	-0.1282	0.0290	1.53	0.2162
2017 TUCSON 4D 4WD	1	-0.0116	-1%	0.0416	-0.0931	0.0700	0.08	0.7805
2017 VELOSTER 3D	1	-1.3791	-75%	0.1752	-1.7224	-1.0358	62.00	<0.0001
2017 VELOSTER TURBO 3D	1	-8.5460	-100%	28.1893	-63.7961	46.7040	0.09	0.7618
2017 SONATA 4D	1	0.2851	33%	0.0282	0.2299	0.3403	102.44	<0.0001
2018 ACCENT 4D	1	-1.0410	-65%	0.0905	-1.2182	-0.8637	132.45	<0.0001
2018 ELANTRA 4D	1	0.0594	6%	0.0268	0.0069	0.1118	4.92	0.0265
2018 ELANTRA GT 5D	1	-1.0595	-65%	0.1049	-1.2652	-0.8539	102.00	<0.0001
2018 KONA 5D 2WD	1	-1.9026	-85%	0.2780	-2.4475	-1.3577	46.83	<0.0001
2018 KONA 5D 4WD	1	-1.8887	-85%	0.2680	-2.4140	-1.3635	49.67	<0.0001
2018 SANTA FE 4D 2WD	1	-1.2463	-71%	0.1900	-1.6187	-0.8739	43.03	<0.0001
2018 SANTA FE 4D 4WD	1	-1.6650	-81%	0.2780	-2.2099	-1.1200	35.86	<0.0001
2018 SANTA FE SPORT 4D 2WD	1	-1.1027	-67%	0.0816	-1.2627	-0.9428	182.53	<0.0001
2018 SANTA FE SPORT 4D 4WD	1	-1.2303	-71%	0.0948	-1.4162	-1.0444	168.30	<0.0001
2018 TUCSON 4D 2WD	1	-0.0995	-9%	0.0459	-0.1894	-0.0096	4.71	0.0300
2018 TUCSON 4D 4WD	1	0.0646	7%	0.0372	-0.0084	0.1375	3.01	0.0827
2018 SONATA 4D	1	0.1412	15%	0.0376	0.0675	0.2150	14.08	0.0002
2019 ACCENT 4D	1	-0.9143	-60%	0.0668	-1.0453	-0.7833	187.06	<0.0001
2019 ELANTRA 4D	1	0.0023	0%	0.0287	-0.0541	0.0586	0.01	0.9373
2019 ELANTRA GT 5D	1	-0.9834	-63%	0.1655	-1.3078	-0.6590	35.30	<0.0001
2019 KONA 4D 2WD	1	-1.5278	-78%	0.1149	-1.7529	-1.3026	176.92	<0.0001
2019 KONA 4D 4WD	1	-1.4871	-77%	0.1203	-1.7229	-1.2514	152.86	<0.0001
2019 SANTA FE 4D 2WD	1	-1.3063	-73%	0.0937	-1.4900	-1.1227	194.37	<0.0001
2019 SANTA FE 4D 4WD	1	-1.5593	-79%	0.0982	-1.7517	-1.3670	252.36	<0.0001
2019 SANTA FE XL 4D 2WD	1	-1.2436	-71%	0.3339	-1.8981	-0.5892	13.87	0.0002
2019 SANTA FE XL 4D 4WD	1	-2.3328	-90%	0.5777	-3.4650	-1.2005	16.31	<0.0001
2019 TUCSON 4D 2WD	1	-0.1184	-11%	0.0485	-0.2134	-0.0234	5.96	0.0146
2019 TUCSON 4D 4WD	1	-0.1704	-16%	0.0451	-0.2588	-0.0821	14.29	0.0002
2019 VELOSTER 3D	1	-1.2895	-72%	0.1678	-1.6184	-0.9606	59.06	<0.0001
2019 SONATA 4D	1	0.1654	18%	0.0369	0.0931	0.2378	20.10	<0.0001
2020 ACCENT 4D	1	-0.7324	-52%	0.0774	-0.8840	-0.5807	89.55	<0.0001
2020 ELANTRA 4D	1	-0.0554	-5%	0.0281	-0.1105	-0.0004	3.90	0.0484
2020 ELANTRA GT 5D	1	-0.9909	-63%	0.2302	-1.4421	-0.5397	18.53	<0.0001
2020 KONA 4D 2WD	1	-1.3264	-73%	0.1316	-1.5844	-1.0684	101.56	<0.0001
2020 KONA 4D 4WD	1	-1.6787	-81%	0.1836	-2.0386	-1.3188	83.57	<0.0001
2020 PALISADE 4D 2WD	1	-1.8860	-85%	0.4087	-2.6871	-1.0849	21.29	<0.0001
2020 PALISADE 4D 4WD	1	-2.1083	-88%	0.4087	-2.9094	-1.3072	26.61	<0.0001
2020 SANTA FE 4D 2WD	1	-1.5273	-78%	0.1295	-1.7812	-1.2735	139.08	<0.0001
2020 SANTA FE 4D 4WD	1	-1.6791	-81%	0.1442	-1.9618	-1.3965	135.61	<0.0001

Appendix: Illustrative regression results — Hyundai theft claim frequency

Parameter	Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
2020 TUCSON 4D 2WD	1	-0.1426	-13%	0.0717	-0.2831	-0.0021	3.95	0.0467
2020 TUCSON 4D 4WD	1	-0.1272	-12%	0.0596	-0.2441	-0.0103	4.55	0.0330
2020 VELOSTER 3D	1	-1.1646	-69%	0.2433	-1.6415	-0.6877	22.91	<0.0001
2020 VENUE 4D 2WD	1	-1.9031	-85%	0.1555	-2.2079	-1.5983	149.75	<0.0001
2021 ACCENT 4D	1	-0.8931	-59%	0.0982	-1.0855	-0.7007	82.80	<0.0001
2021 ELANTRA 4D	1	-0.4832	-38%	0.0732	-0.6266	-0.3398	43.60	<0.0001
2021 KONA 4D 2WD	1	-1.1637	-69%	0.1520	-1.4617	-0.8658	58.60	<0.0001
2021 KONA 4D 4WD	1	-1.4706	-77%	0.1594	-1.7829	-1.1582	85.15	<0.0001
2021 PALISADE 4D 2WD	1	-2.5928	-93%	0.5777	-3.7251	-1.4606	20.14	<0.0001
2021 PALISADE 4D 4WD	1	-1.7257	-82%	0.3339	-2.3801	-1.0712	26.71	<0.0001
2021 SANTA FE 4D 2WD	1	-1.5774	-79%	0.2508	-2.0689	-1.0859	39.56	<0.0001
2021 SANTA FE 4D 4WD	1	-1.7037	-82%	0.2433	-2.1806	-1.2268	49.03	<0.0001
2021 TUCSON 4D 2WD	1	-0.0777	-7%	0.0776	-0.2299	0.0745	1.00	0.3170
2021 TUCSON 4D 4WD	1	-0.2570	-23%	0.0869	-0.4273	-0.0867	8.75	0.0031
2021 VELOSTER 3D	1	-0.7353	-52%	0.7074	-2.1217	0.6512	1.08	0.2986
2021 VENUE 4D 2WD	1	-2.0201	-87%	0.1537	-2.3214	-1.7188	172.65	<0.0001
2022 ACCENT 4D	1	-1.0878	-66%	0.2508	-1.5793	-0.5964	18.82	<0.0001
2022 ELANTRA 4D	1	-0.4844	-38%	0.1934	-0.8635	-0.1053	6.27	0.0123
2022 KONA 4D 2WD	1	-1.6725	-81%	0.3169	-2.2935	-1.0515	27.86	<0.0001
2022 KONA 4D 4WD	1	-2.2076	-89%	0.3541	-2.9016	-1.5135	38.86	<0.0001
2022 SANTA FE 4D 2WD	1	-0.8481	-57%	0.3785	-1.5899	-0.1062	5.02	0.0251
2022 SANTA FE 4D 4WD	1	-1.5023	-78%	0.4087	-2.3034	-0.7012	13.51	0.0002
2022 TUCSON 4D 2WD	1	-1.2966	-73%	0.2303	-1.7479	-0.8453	31.71	<0.0001
2022 TUCSON 4D 4WD	1	-1.8303	-84%	0.2433	-2.3072	-1.3534	56.58	<0.0001
2013 ELANTRA 4D	1	-0.2978	-26%	0.0251	-0.3470	-0.2486	140.76	<0.0001
2013 ELANTRA GT 5D	1	-1.2491	-71%	0.0818	-1.4095	-1.0887	233.06	<0.0001
2013 GENESIS COUPE 2D	1	-1.8073	-84%	0.1752	-2.1506	-1.4639	106.45	<0.0001
2013 SANTA FE 4D 2WD	1	-1.3192	-73%	0.2191	-1.7486	-0.8898	36.26	<0.0001
2013 SANTA FE 4D 4WD	1	-1.4539	-77%	0.2094	-1.8644	-1.0434	48.19	<0.0001
2013 SANTA FE SPORT 4D 2WD	1	-1.8949	-85%	0.0882	-2.0677	-1.7221	461.72	<0.0001
2013 SANTA FE SPORT 4D 4WD	1	-1.8761	-85%	0.0973	-2.0669	-1.6854	371.67	<0.0001
2013 TUCSON 4D 2WD	1	-1.1921	-70%	0.0904	-1.3694	-1.0148	173.71	<0.0001
2013 TUCSON 4D 4WD	1	-1.2226	-71%	0.1128	-1.4437	-1.0015	117.45	<0.0001
2013 VELOSTER 3D	1	-1.7842	-83%	0.1427	-2.0639	-1.5045	156.30	<0.0001
2013 SONATA 4D	0	0	0	0	0	0	0	0
Anti-theft software	1	-0.7984	-55%	0.0145	-0.8268	-0.7700	3033.37	<0.0001



4121 Wilson Boulevard, 6th floor  
Arlington, VA 22203  
+1 703 247 1500  
iihs-hldi.org

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