HLDI
Highway Loss Data Institute

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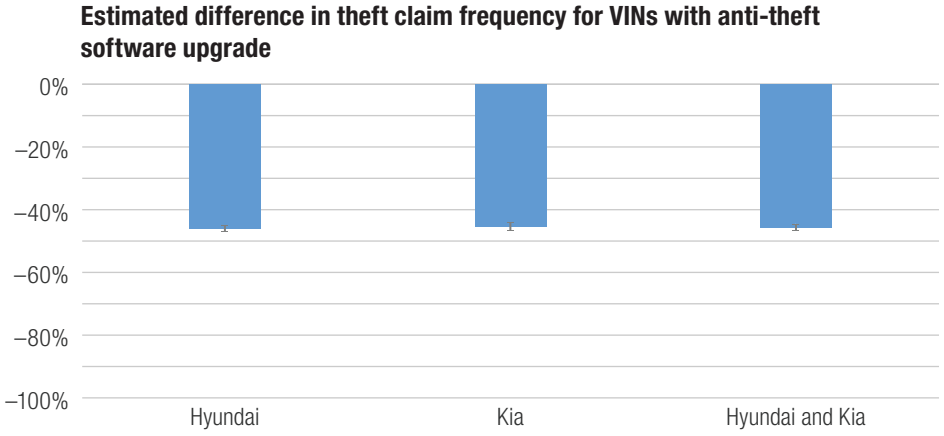
Reductions in Hyundai and Kia comprehensive losses associated with the anti-theft software upgrade

Summary

An increase in theft claim frequency for Hyundai and Kia vehicles, in particular for older series without standard passive immobilizers, 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 affect more model years and states, and vandalism claim frequency has risen as well. In response, in February 2023 Hyundai and Kia began implementing a software update to deter vehicle thefts. As part of this effort, Hyundai and Kia collaborated with the Highway Loss Data Institute (HLDI) by providing the Vehicle Identification Numbers (VINs) of the vehicles eligible for the software upgrade as well as information about which vehicles received it.

HLDI's analysis indicates significant reductions in theft claim frequency associated with the Hyundai and Kia software upgrade. As shown in the figure, theft claim frequency for Hyundai vehicles that were upgraded was 46% lower than that for vehicles that were not. Upgraded Kia vehicles also showed a significant 45% reduction in theft claim frequency compared with those without the software upgrade. When combined, Hyundai–Kia vehicles that were upgraded exhibited a significant 46% decrease in theft claim frequency compared with vehicles that were not upgraded.



The anti-theft software upgrade is also correlated with reductions in whole vehicle theft claim frequency. However, vandalism claim frequency increased for Hyundai–Kia vehicles that were upgraded, possibly 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 (Highway Loss Data Institute [HLDI], 2021). The lack of immobilizers has made many Hyundai and Kia vehicles easier targets for thieves, contributing to a rise in theft claim frequencies for these series.

To address the problem, in February 2023 Hyundai and Kia introduced a software upgrade for some affected vehicles. According to Hyundai and Kia, after it is upgraded, a vehicle will start only if a key is in the ignition. To set the factory alarm and activate this ignition "kill" feature, the driver must lock the doors with the key fob when exiting the vehicle; the kill feature remains active even after the vehicle's alarm stops sounding. Upgraded vehicles receive a window sticker intended to deter potential thieves.

This bulletin evaluates the anti-theft software upgrade by analyzing the frequencies of theft claims, whole vehicle theft claims, and vandalism claims for Hyundai and Kia vehicles. It updates prior analysis (HLDI, 2024a, 2024b) with an additional 6 months of data, from July to December 2024.

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 originate from three different types of theft: theft of vehicle contents, 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 theft of vehicle components 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, 2025b).

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 claim frequency, whole vehicle theft claim frequency, and vandalism claim frequency.

Subject vehicles

Hyundai and Kia provided HLDI with the Vehicle Identification Numbers (VINs) of the vehicles eligible for the anti-theft software upgrade, along with information on whether or not they received the upgrade and, if they did, when. This study focuses on the VINs from model years 2011 to 2022 provided by Hyundai and Kia that were eligible to receive an anti-theft software upgrade. **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

Hyundai series	Model years
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

Kia series	Model years
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

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 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 had been upgraded in January 2023); thus, the comparison was limited to calendar years 2023 and 2024, with the calendar year and month 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, claims and exposure after February would be categorized as upgraded. However, not every upgraded VIN from Hyundai and Kia aligned with available policy data in the HLDI loss database for the corresponding year and month. For example, if Hyundai reported that a VIN was upgraded in May 2023 but its policy data in HLDI records extend only to March 2023, then this vehicle's claims and exposure would be categorized as if the vehicle had not 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 was multiplied by 100. For example, the estimate of the difference in theft claim frequency between Hyundai VINs that received the anti-theft software upgrade and those that did not was −0.6175; thus, the theft claim frequency of vehicles with the anti-theft software upgrade was 46% lower than vehicles without the upgrade ($[\exp(-0.6175) - 1] \times 100 = -46$).

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 2024, the national trend remained relatively stable, with an average theft claim frequency of less than three claims per 1,000 insured vehicle years for all months.

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

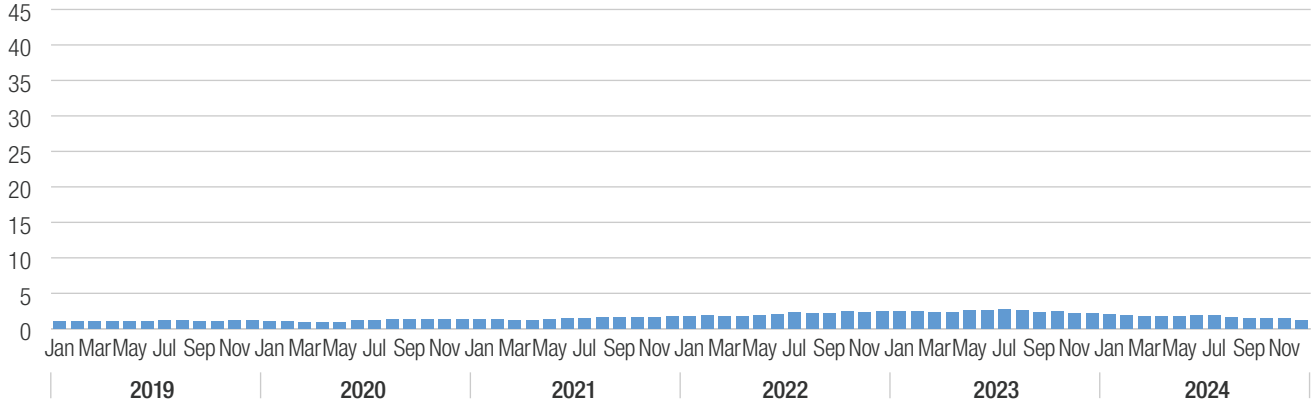


Figure 2 shows the theft claim frequency by month for all Hyundai and Kia series for model years 2011–22. Before 2020, theft claim frequencies for Hyundai and Kia vehicles closely approximated the national average. However, from mid-2020 onward, the theft claim frequencies for these vehicles showed an upward trend and remained consistently higher than the national average until July 2023, when a downward trend began and continued through 2024. By December 2024, the theft claim frequency stood at approximately five claims per 1,000 insured vehicle years for Hyundai and six claims for Kia.

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

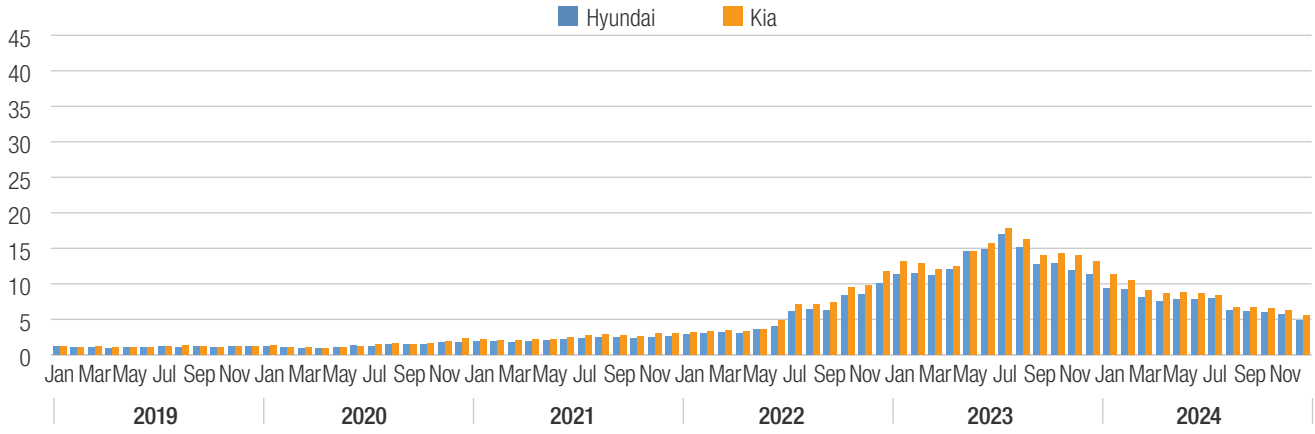


Figure 3 further narrows the focus by illustrating the theft claim frequency by month for model year 2011–22 Hyundai and Kia vehicle series eligible for the anti-theft software upgrade. The theft claim frequencies for these upgradable series were slightly higher than those for all Hyundai and Kia series (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

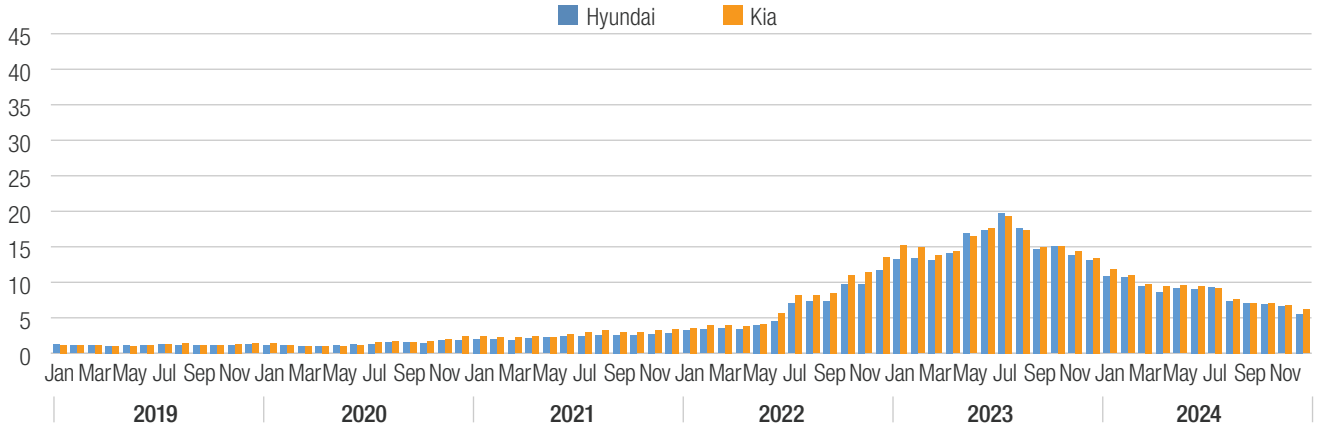
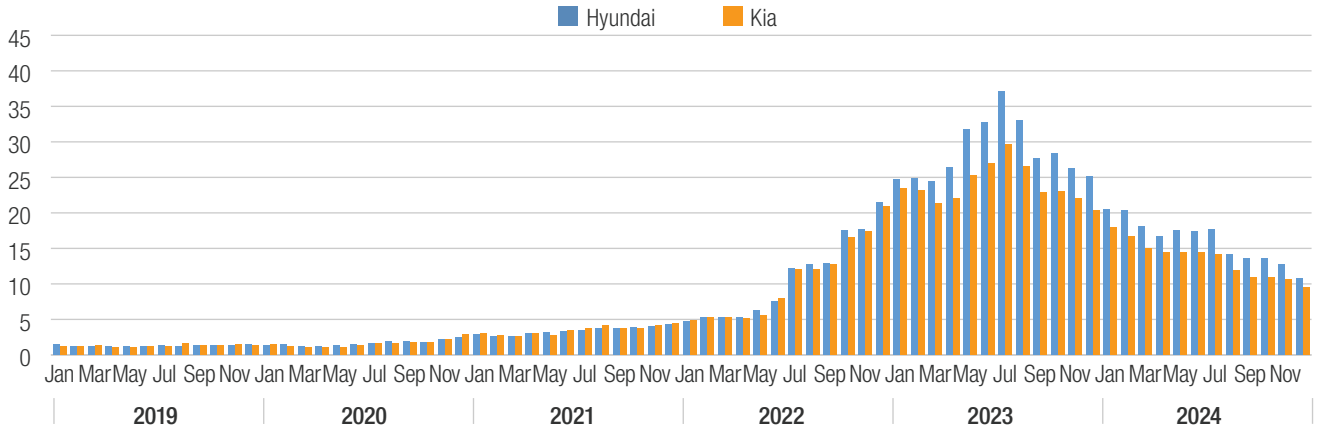


Figure 4 narrows the trend to the VINs provided by Hyundai and Kia that were identified as having the highest risk of theft. As shown in the figure, these upgradable VINs exhibited extremely high theft claim frequencies, in some instances exceeding 37 claims per 1,000 insured vehicle years.

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



Figures 1–4 collectively display 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 using the VINs provided by Hyundai and Kia. Given that the anti-theft software upgrade began in February 2023 for both Hyundai and Kia, only calendar years 2023 and 2024 were included in this analysis.

Figure 5 shows the theft claim frequency for Hyundai VINs that received the software upgrade versus those that did not by month for calendar years 2023 and 2024. Throughout this period, Hyundai VINs that were upgraded exhibited lower theft claim frequencies than the VINs that were not upgraded. In 2024, theft claim frequencies declined for both groups. As a result, the gap between upgraded and non-upgraded vehicles narrowed over time, particularly in the second half of the year.

As shown in Figure 6, the theft claim frequency for upgraded Kia VINs was also lower than that for the non-upgraded Kia VINs in every month of this period except for February 2023. 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 years 2023–24

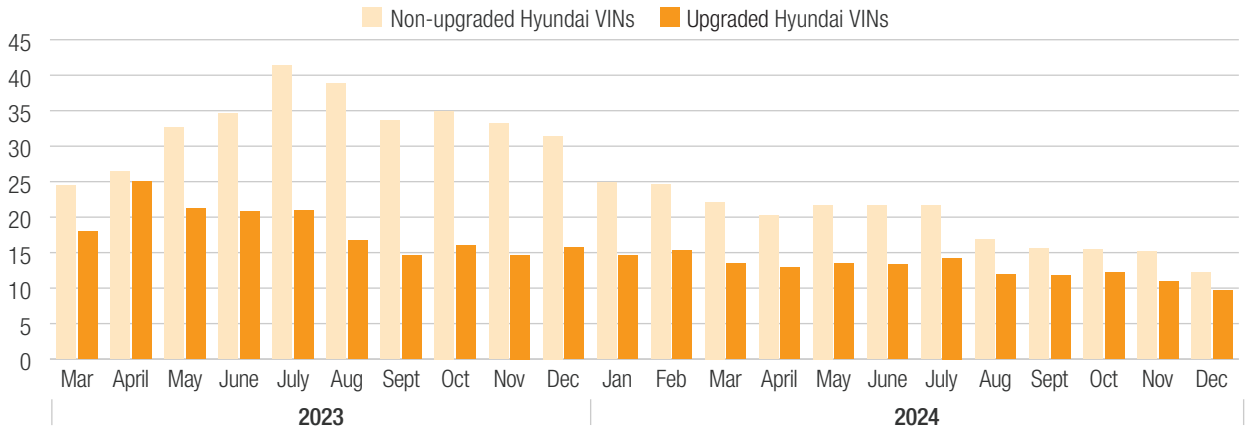


Figure 6: Kia theft claim frequency by month, calendar years 2023–24

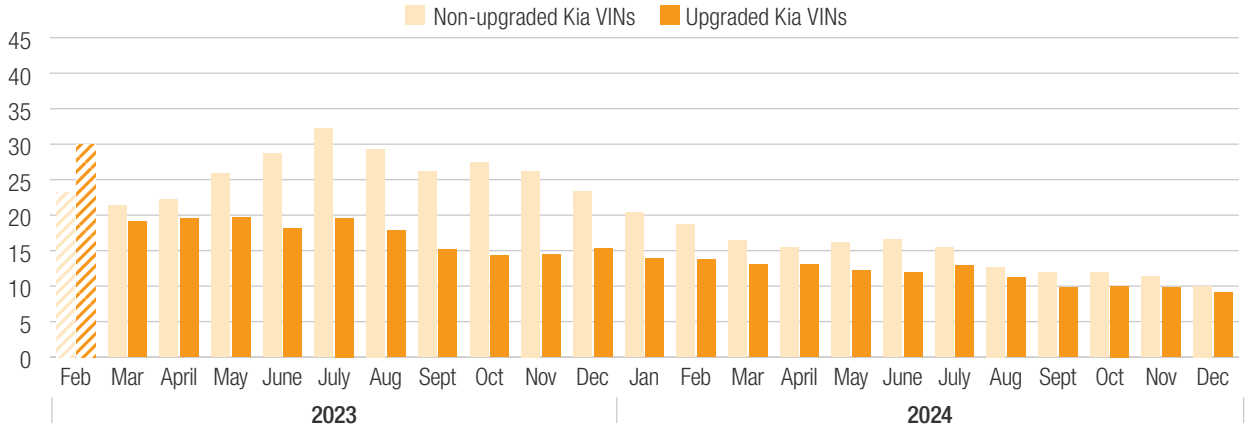
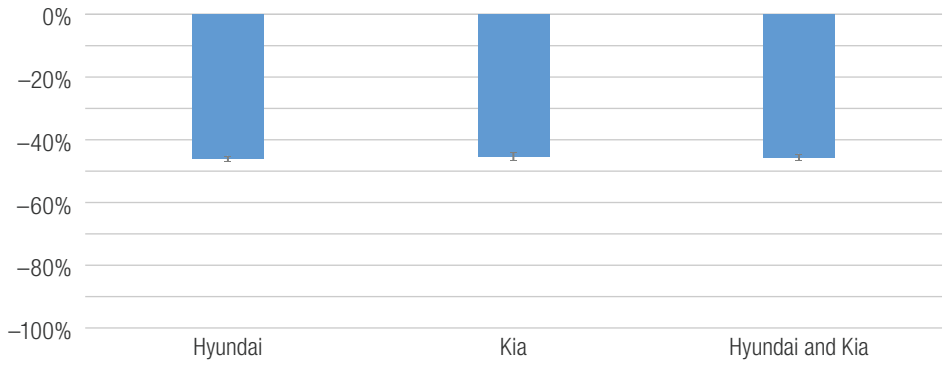


Figure 7 shows the estimated difference in theft claim frequency between upgraded and non-upgraded VINs from Hyundai, Kia, and Hyundai–Kia combined. The theft claim frequency for Hyundai vehicles that were upgraded decreased significantly by 46% compared with those that were not. Similarly, upgraded Kia vehicles exhibited a significant 45% reduction compared to non-upgraded vehicles. When combined, Hyundai–Kia vehicles that were upgraded showed a significant 46% decrease in theft claim frequency compared with those that were not upgraded.

Figure 7: Estimated difference in theft claim frequency for VINs with anti-theft software upgrade



Whole vehicle theft claim frequency

Figure 8 illustrates the monthly whole vehicle theft claim frequency for model year 2011–22 Hyundai and Kia vehicles eligible for the anti-theft software upgrade. The whole vehicle theft claim frequency started to rise in 2021 and continued to increase throughout 2022 and the first half of 2023. However, it began to decline in the second half of 2023 and continued to decrease throughout 2024. By December 2024, the whole vehicle theft claim frequency had dropped to fewer than two claims per 1,000 insured vehicle years for these selected Hyundai and Kia series.

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

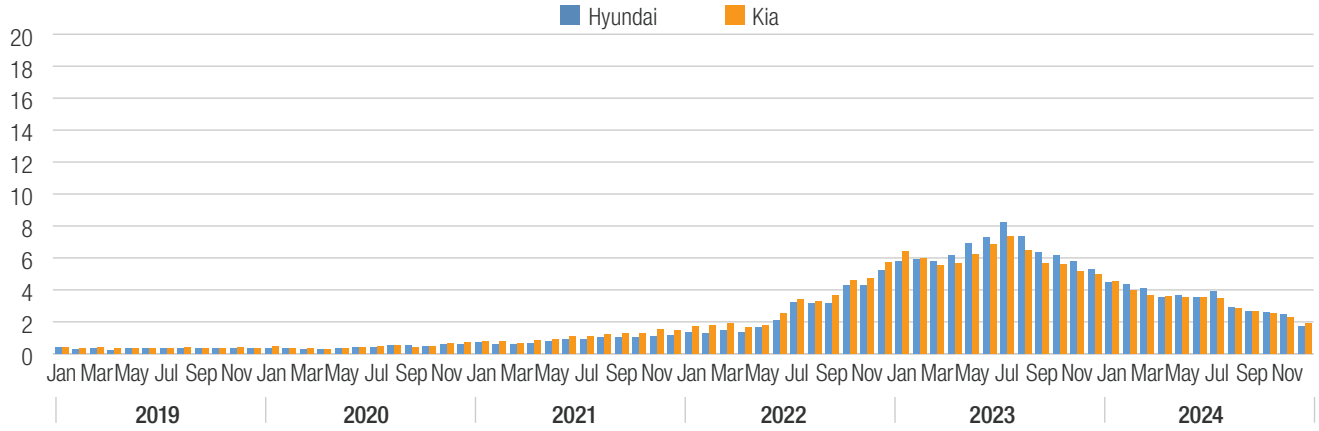
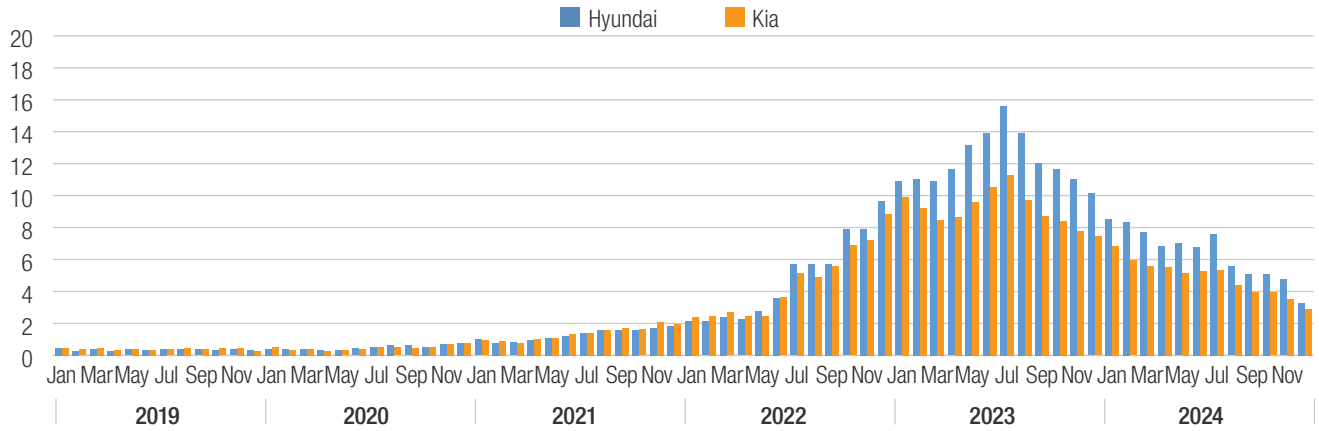


Figure 9 illustrates the monthly whole vehicle theft claim frequency for upgradable VINs provided by Hyundai and Kia for model years 2011–22. The trend observed for these vehicles parallels that of the upgradable Hyundai and Kia vehicles series (Figure 8) but with a higher frequency of whole vehicle 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, again using VINs provided by Hyundai and Kia as the study population. The whole vehicle theft trends for both Hyundai and Kia vehicles are similar to those for theft. Upgraded Hyundai VINs consistently exhibited lower whole vehicle theft claim frequencies compared with their non-upgraded counterparts in 2023 and 2024. The whole vehicle theft claim frequency of upgraded Kia VINs was also lower than the non-upgraded Kia VINs in each month except for February 2023. The difference between the two groups narrowed in 2024, particularly in the second half of the year, as claim frequencies declined for both upgraded and non-upgraded vehicles.

Figure 10: Hyundai whole vehicle theft claim frequency by month, calendar years 2023–24

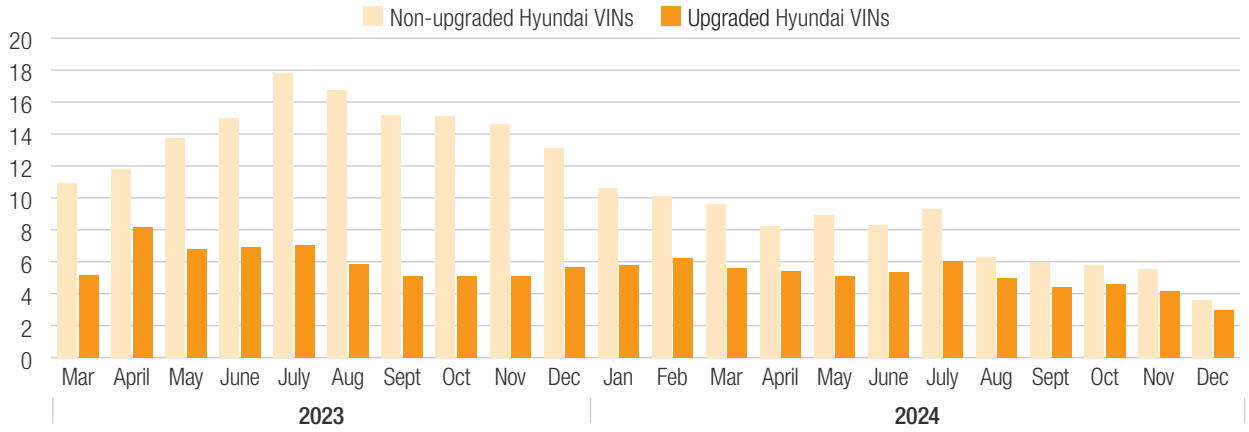


Figure 11: Kia whole vehicle theft claim frequency by month, calendar years 2023–24

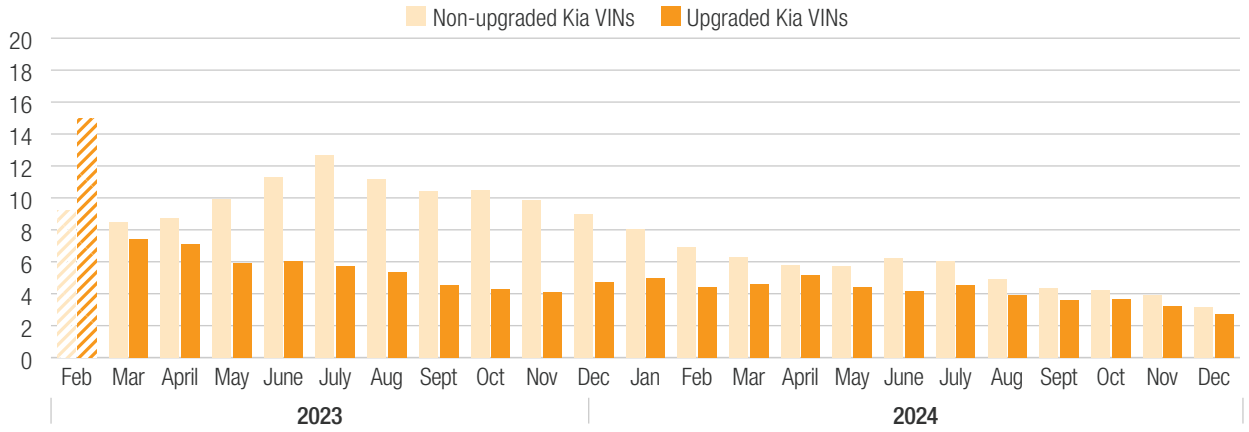
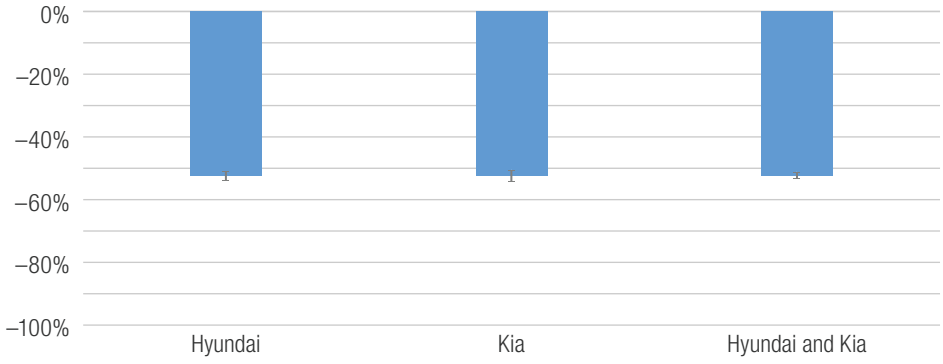


Figure 12 shows the estimated difference in whole vehicle theft claim frequency between upgraded and non-upgraded VINs from Hyundai, Kia, and Hyundai–Kia combined. The whole theft claim frequency decreased significantly by 52% across all three groups compared with VINs that did not receive the upgrade.

Figure 12: Estimated difference in whole vehicle theft claim frequency for VINs with anti-theft software



Vandalism claim frequency

Figures 13 and 14 show the monthly vandalism claim frequency for upgraded and non-upgraded Hyundai and Kia VINs in 2023 and 2024. Unlike theft and whole vehicle theft, the vandalism claim frequency for VINs that were upgraded was higher than that for VINs that were not upgraded for both Hyundai and Kia throughout this period. However, vandalism claim frequencies declined for both upgraded and non-upgraded vehicles in 2024.

Figure 13: Hyundai vandalism claim frequency by month, calendar years 2023–24

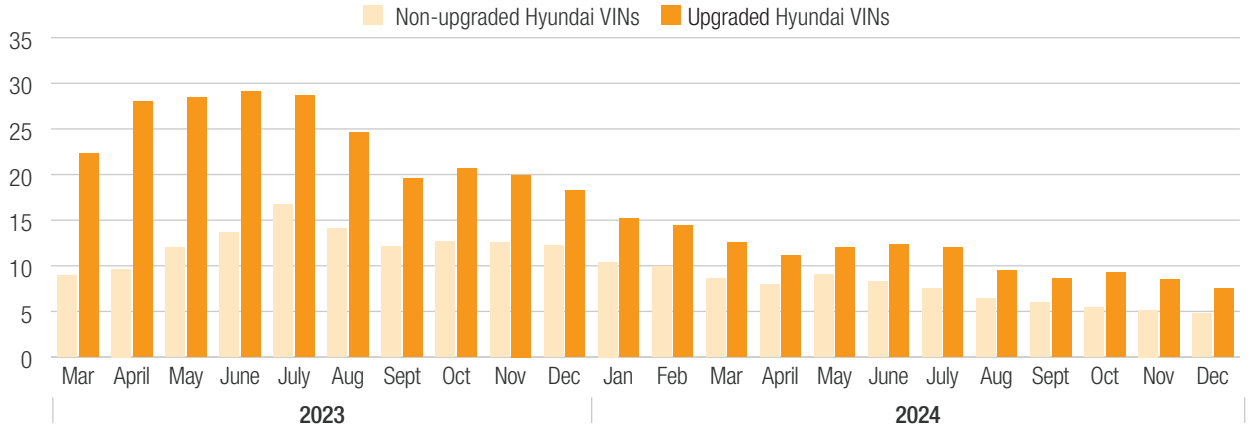


Figure 14: Kia vandalism claim frequency by month, calendar years 2023–24

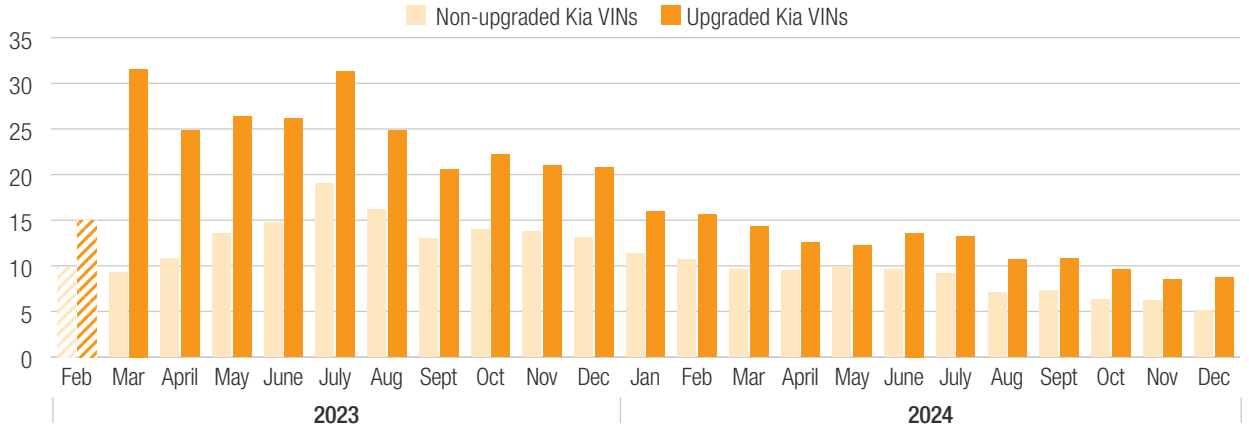
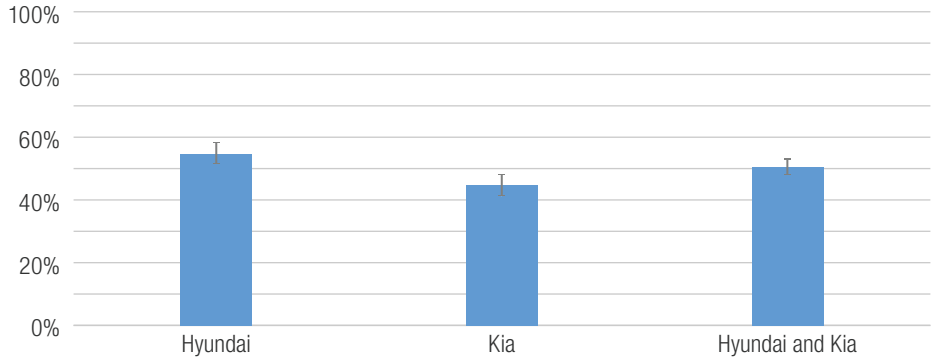


Figure 15 shows the estimated difference in vandalism claim frequency between upgraded and non-upgraded VINs from Hyundai, Kia, and Hyundai–Kia combined. The vandalism claim frequency increased significantly by 55% for Hyundai and 45% for Kia. When combined, upgraded Hyundai–Kia vehicles showed a 50% increase in vandalism claim frequency compared with those that did not receive the upgrade.

Figure 15: Estimated difference in vandalism claim frequency for VINs with anti-theft software



Discussion

Theft claim frequencies for Hyundai and Kia vehicles have been notably higher than the national average since 2021. An anti-theft software upgrade began in February 2023. Despite a downward trend observed after mid-2023, theft remained a persistent issue for Hyundai and Kia vehicles. By December 2024, the theft claim frequency of 2011–22 upgradable VINs was still high, at nearly 11 claims per 1,000 insured vehicle years for Hyundai and 10 claims for Kia, but had decreased from peak levels in mid-2023 by 71% for Hyundai and 68% for Kia.

Hyundai and Kia VINs that were upgraded showed lower theft claim frequencies compared with their non-upgraded counterparts. There was a significant 46% 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, a significant 52%. These findings indicate that the anti-theft software upgrade is correlated with reductions in theft and appeared to provide some theft protection. However, the upgrade may have inadvertently led to an increase in vandalism incidents. Hyundai and Kia vehicles that received the software upgrade had a significant 50% increase in vandalism claim frequency compared to those that did not receive the upgrade. If would-be thieves mistakenly target an upgraded Hyundai or Kia vehicle, they may cause damage during an unsuccessful theft attempt. Consequently, a vandalism claim is filed rather than a theft claim.

Interestingly, theft claim frequencies for non-upgraded VINs also showed a downward trend, particularly in the second half of 2024. The gap between upgraded and non-upgraded VINs narrowed during this period, resulting in a slightly smaller percentage reduction in theft claim frequency (46% compared to 48%) for the anti-theft software upgrade relative to the previous report (HLDI, 2024b). This smaller reduction may reflect a positive trend, suggesting that thieves are no longer targeting Hyundai and Kia vehicles as often. A companion study found that the theft claim frequency for all 2003–23 Hyundai and Kia vehicles, regardless of software upgrade status, dropped 56% in the second half of 2024 compared with the second half of 2023 (HLDI, 2025a). Whole vehicle theft also exhibited this trend, with the gap between upgraded and non-upgraded VINs narrowing in 2024.

Although theft rates for Hyundai and Kia vehicles remain relatively high, they have declined substantially from peak levels. This decline is likely related to the rollout of the software upgrade and increased awareness, which may have deterred theft attempts not only on upgraded vehicles but also on vehicles not yet upgraded. However, while vandalism rates in general are declining, the anti-theft software upgrade is correlated with elevated vandalism rates for Hyundai and Kia vehicles.

Upgraded population group

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

- **Upgradable series:** VINs 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 VINs in the current HLDI database.
- **Upgraded VINs:** Upgradable VINs that have received the software upgrade.

As of December 2024, Hyundai had deployed the anti-theft software upgrade in 41% of the upgradable VINs, which corresponds to 22% of all Hyundai upgradable series present in the HLDI database. Kia had implemented the upgrade in 40% of the upgradable VINs, representing 25% of all Kia upgradable series within the HLDI data.

Table 3: Hyundai and Kia VIN count summary

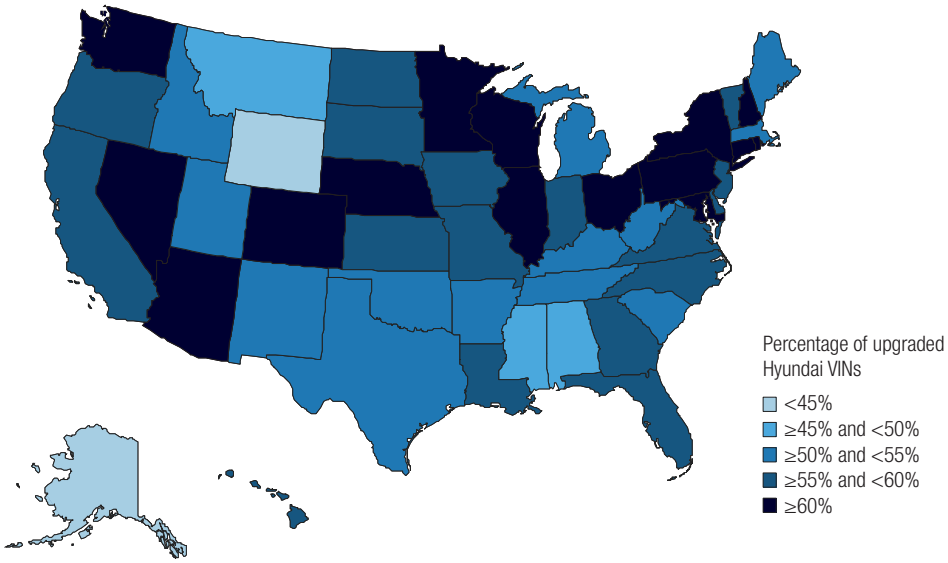
Make	Upgradable series	Upgradable VINs	Upgraded VINs*	Percentage of upgraded VINs in upgradable VINs	Percentage of upgraded VINs in upgradable series
Hyundai	6,413,766	3,543,639	1,435,378	41%	22%
Kia	4,675,584	2,909,459	1,162,236	40%	25%

* Upgraded VINs through December 2024.

Maps 1 and 2 display the upgradable VINs that received the software upgrade by state. The maps include only upgradable VINs for which HLDI had an insurance record in December 2024, 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 2024. This may be because a vehicle was totaled and thus was removed from the vehicle fleet, the owner dropped their comprehensive coverage, or the owner switched insurance carriers to one that doesn't supply HLDI with loss data. It is important to note that the state represents the garaging state of each VIN, not necessarily the state where the software upgrade occurred.

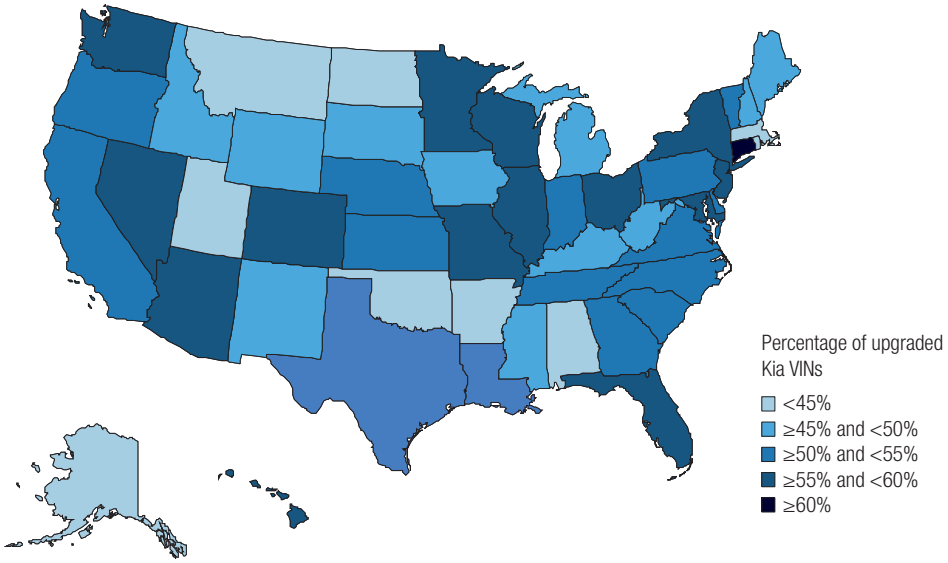
Map 1 shows the percentage of upgraded Hyundai VINs by state. The implementation rate of the software upgrade for Hyundai ranges from 42% to 73%. The District of Columbia and Minnesota have the highest implementation rates and Wyoming has the lowest.

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 that for Hyundai. The District of Columbia and Connecticut have the highest rollout rates of 67% and 61%, respectively, while Alaska, at 27%, has 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. (2024a). Reductions in Hyundai and Kia comprehensive losses associated with the anti-theft software upgrade. *Loss Bulletin*, *41*(18).

Highway Loss Data Institute. (2024b). Reductions in Hyundai and Kia comprehensive losses associated with the anti-theft software upgrade. *Loss Bulletin*, *41*(30).

Highway Loss Data Institute. (2025a). Hyundai and Kia theft and vandalism losses. *Loss Bulletin*, *42*(6).

Highway Loss Data Institute. (2025b). *Whole vehicle theft losses* (Insurance Report WT-24).

Appendix

Table A1: 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	–9.7740		0.0320	–9.8368	–9.7112	93156.90	<0.0001
State	Alabama	1	0.6965	101%	0.0557	0.5873	0.8058	156.19	<0.0001
	Alaska	1	1.9564	607%	0.1395	1.6830	2.2297	196.73	<0.0001
	Arizona	1	1.7496	475%	0.0359	1.6792	1.8200	2373.29	<0.0001
	Arkansas	1	0.8743	140%	0.0915	0.6949	1.0536	91.31	<0.0001
	California	1	2.1685	775%	0.0240	2.1215	2.2154	8191.75	<0.0001
	Colorado	1	2.4595	1070%	0.0314	2.3980	2.5209	6145.05	<0.0001
	Connecticut	1	1.7851	496%	0.0323	1.7219	1.8484	3059.62	<0.0001
	Delaware	1	1.2716	257%	0.0626	1.1488	1.3944	412.15	<0.0001
	District of Columbia	1	3.4156	2944%	0.0371	3.3430	3.4883	8491.22	<0.0001
	Georgia	1	0.9585	161%	0.0321	0.8955	1.0215	889.30	<0.0001
	Hawaii	1	0.2152	24%	0.1161	–0.0125	0.4428	3.43	0.0639
	Idaho	1	0.2395	27%	0.1448	–0.0444	0.5234	2.73	0.0982
	Illinois	1	1.7604	481%	0.0270	1.7076	1.8133	4266.91	<0.0001
	Indiana	1	1.1915	229%	0.0408	1.1116	1.2715	854.09	<0.0001
	Iowa	1	1.0776	194%	0.0679	0.9446	1.2106	252.17	<0.0001
	Kansas	1	1.9281	588%	0.0434	1.8431	2.0131	1977.23	<0.0001
	Kentucky	1	1.3403	282%	0.0414	1.2592	1.4215	1048.77	<0.0001
	Louisiana	1	1.7129	455%	0.0434	1.6278	1.7979	1557.83	<0.0001
	Maine	1	–0.3217	–28%	0.2055	–0.7246	0.0811	2.45	0.1175
	Maryland	1	2.4547	1064%	0.0252	2.4053	2.5041	9486.57	<0.0001
	Massachusetts	1	0.3928	48%	0.0413	0.3118	0.4738	90.35	<0.0001
	Michigan	1	1.4791	339%	0.0467	1.3875	1.5706	1001.93	<0.0001
	Minnesota	1	2.1028	719%	0.0321	2.0398	2.1658	4282.38	<0.0001
	Mississippi	1	1.7382	469%	0.0611	1.6184	1.8580	808.52	<0.0001
	Missouri	1	1.9906	632%	0.0322	1.9276	2.0537	3829.84	<0.0001
	Montana	1	0.9685	163%	0.2201	0.5370	1.3999	19.35	<0.0001
	Nebraska	1	2.1295	741%	0.0438	2.0436	2.2153	2362.00	<0.0001
	Nevada	1	3.1335	2195%	0.0302	3.0743	3.1928	10750.40	<0.0001
	New Hampshire	1	–0.3189	–27%	0.1784	–0.6685	0.0308	3.19	0.0739
	New Jersey	1	0.7322	108%	0.0324	0.6687	0.7957	510.79	<0.0001
	Nex Mexico	1	2.5675	1203%	0.0486	2.4723	2.6627	2792.71	<0.0001
	New York	1	1.4619	331%	0.0274	1.4082	1.5156	2848.83	<0.0001
	North Carolina	1	1.4539	328%	0.0305	1.3942	1.5136	2279.20	<0.0001
	North Dakota	1	1.8868	560%	0.1456	1.6014	2.1721	167.95	<0.0001
	Ohio	1	1.5871	389%	0.0281	1.5321	1.6422	3193.15	<0.0001
	Oklahoma	1	0.2624	30%	0.0685	0.1280	0.3967	14.65	0.0001
	Oregon	1	1.8968	566%	0.0420	1.8144	1.9792	2035.59	<0.0001
	Pennsylvania	1	1.4525	327%	0.0279	1.3978	1.5072	2708.95	<0.0001
	Rhode Island	1	0.1770	19%	0.0841	0.0120	0.3419	4.42	0.0355
	South Carolina	1	0.7268	107%	0.0509	0.6269	0.8267	203.49	<0.0001
	South Dakota	1	1.9686	616%	0.1246	1.7245	2.2127	249.80	<0.0001
	Tennessee	1	1.4146	311%	0.0357	1.3445	1.4846	1568.32	<0.0001

Table A1: Illustrative regression results — Hyundai theft claim frequency									
Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	*p* value
	Texas	1	1.2040	233%	0.0268	1.1514	1.2567	2011.76	<0.0001
	Utah	1	–0.1095	–10%	0.0726	–0.2517	0.0327	2.28	0.1314
	Vermont	1	0.8990	146%	0.2513	0.4066	1.3915	12.80	0.0003
	Virginia	1	0.9714	164%	0.0317	0.9093	1.0335	939.16	<0.0001
	Washington	1	2.6932	1378%	0.0273	2.6397	2.7467	9737.44	<0.0001
	West Virginia	1	0.1416	15%	0.1434	–0.1395	0.4226	0.97	0.3235
	Wisconsin	1	1.6037	397%	0.0415	1.5224	1.6850	1495.61	<0.0001
	Wyoming	1	1.6285	410%	0.2150	1.2071	2.0500	57.36	<0.0001
	Texas	0	0	0	0	0	0	0	0
Risk	Nonstandard	1	–0.1139	–11%	0.0126	–0.1386	–0.0892	81.70	<0.0001
	Standard	0	0	0	0	0	0	0	0
Rated driver age group	14–24	1	–0.1326	–12%	0.0141	–0.1602	–0.1051	88.85	<0.0001
	25–29	1	0.0768	8%	0.0119	0.0534	0.1002	41.35	<0.0001
	40–49	1	–0.1242	–12%	0.0122	–0.1480	–0.1003	104.09	<0.0001
	50–59	1	–0.1783	–16%	0.0125	–0.2027	–0.1539	205.15	<0.0001
	60–64	1	–0.2877	–25%	0.0165	–0.3200	–0.2554	304.62	<0.0001
	65–69	1	–0.3413	–29%	0.0179	–0.3764	–0.3062	363.43	<0.0001
	70+	1	–0.6258	–47%	0.0156	–0.6563	–0.5952	1611.96	<0.0001
	Unknown	1	–0.1024	–10%	0.0305	–0.1621	–0.0426	11.28	0.0008
	30–39	0	0	0	0	0	0	0	0
Rated driver gender	Male	1	–0.0183	–3%	0.0077	–0.0410	–0.0111	11.60	0.0007
	Unknown	1	–0.0435	7%	0.0285	0.0145	0.1262	6.10	0.0135
	Female	0	0	0%	0	0	0	0	0
Rated driver marital status	Married	1	–0.3828	–32%	0.0085	–0.3994	–0.3661	2025.85	<0.0001
	Unknown	1	–0.1846	–17%	0.0335	–0.2502	–0.1190	30.40	<0.0001
	Single	0	0	0	0	0	0	0	0
Deductible range	0–250	1	–0.2143	–19%	0.0094	–0.2327	–0.1959	522.68	<0.0001
	501–1,000	1	0.0393	4%	0.0091	0.0214	0.0573	18.53	<0.0001
	1,001+	1	–0.0196	–2%	0.0208	–0.0605	0.0212	0.89	0.3463
	251–500	0	0	0	0	0	0	0	0
Registered vehicle density	0–99	1	–1.4864	–77%	0.0173	–1.5203	–1.4524	7361.69	<0.0001
	100–499	1	–0.9645	–62%	0.0100	–0.9841	–0.9450	9330.17	<0.0001
	500+	0	0	0	0	0	0	0	0
Calendar year and month	2023 March	1	–0.2601	–23%	0.0218	–0.3029	–0.2174	142.3	<0.0001
	2023 Apri	1	–0.1597	–15%	0.0216	–0.202	–0.1173	54.65	<0.0001
	2023 May	1	0.048	5%	0.0206	0.0077	0.0884	5.44	0.0197
	2023 June	1	0.1081	11%	0.0206	0.0677	0.1485	27.48	<0.0001
	2023 July	1	0.2689	31%	0.02	0.2297	0.308	181.16	<0.0001
	2023 August	1	0.1833	20%	0.0205	0.1431	0.2234	80.09	<0.0001
	2023 September	1	0.0357	4%	0.0215	–0.0064	0.0779	2.76	0.0966
	2023 October	1	0.0834	9%	0.0213	0.0417	0.1251	15.39	<0.0001
	2023 November	1	0.0243	2%	0.0219	–0.0186	0.0672	1.23	0.2670
	2024 January	1	–0.1836	–17%	0.0234	–0.2295	–0.1378	61.71	<0.0001
	2024 February	1	–0.1707	–16%	0.0239	–0.2176	–0.1238	50.92	<0.0001
	2024 March	1	–0.2785	–24%	0.0244	–0.3263	–0.2307	130.47	<0.0001

Table A1: Illustrative regression results — Hyundai theft claim frequency									
Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	*p* value
	2024 April	1	–0.342	–29%	0.0253	–0.3916	–0.2925	182.97	<0.0001
	2024 May	1	–0.2765	–24%	0.0247	–0.3249	–0.2281	125.3	<0.0001
	2024 June	1	–0.2759	–24%	0.0251	–0.3252	–0.2267	120.53	<0.0001
	2024 July	1	–0.2445	–22%	0.0248	–0.2931	–0.1959	97.25	<0.0001
	2024 August	1	–0.4533	–36%	0.0267	–0.5055	–0.401	289.15	<0.0001
	2024 September	1	–0.4936	–39%	0.0275	–0.5475	–0.4397	322.17	<0.0001
	2024 October	1	–0.4794	–38%	0.0272	–0.5328	–0.426	309.6	<0.0001
	2024 November	1	–0.5397	–42%	0.0283	–0.5951	–0.4842	363.92	<0.0001
	2024 December	1	–0.7014	–50%	0.0298	–0.7598	–0.6430	554.19	<0.0001
	2023 December	0	0	0	0	0	0	0	0
Vehicle model year and series	2011 SONATA 4D	1	–0.1022	–10%	0.0244	–0.1501	–0.0543	17.49	<0.0001
	2011 TUCSON 4D 2WD	1	–1.4145	–76%	0.0717	–1.5550	–1.2740	389.30	<0.0001
	2011 TUCSON 4D 4WD	1	–1.4986	–78%	0.1007	–1.6961	–1.3012	221.26	<0.0001
	2011 ELANTRA 4D	1	–0.2699	–24%	0.0329	–0.3344	–0.2054	67.31	<0.0001
	2012 SONATA 4D	1	–0.0968	–9%	0.0262	–0.1482	–0.0455	13.65	0.0002
	2012 TUCSON 4D 2WD	1	–1.2994	–73%	0.0649	–1.4265	–1.1722	401.39	<0.0001
	2012 TUCSON 4D 4WD	1	–1.3410	–74%	0.0816	–1.5009	–1.1812	270.27	<0.0001
	2012 VELOSTER 3D	1	–1.5808	–79%	0.1122	–1.8006	–1.3609	198.61	<0.0001
	2012 ELANTRA 4D	1	–0.3877	–32%	0.0275	–0.4416	–0.3337	198.55	<0.0001
	2013 ELANTRA GT 5D	1	–1.4782	–77%	0.0691	–1.6137	–1.3427	457.00	<0.0001
	2013 GENESIS COUPE 2D	1	–1.8372	–84%	0.1345	–2.1009	–1.5735	186.51	<0.0001
	2013 SANTA FE 4D 2WD	1	–1.4464	–76%	0.1775	–1.7942	–1.0986	66.43	<0.0001
	2013 SANTA FE 4D 4WD	1	–1.6091	–80%	0.1722	–1.9467	–1.2716	87.30	<0.0001
	2013 SANTA FE SPORT 4D 2WD	1	–2.1094	–88%	0.0731	–2.2526	–1.9662	833.02	<0.0001
	2013 SANTA FE SPORT 4D 4WD	1	–2.0052	–87%	0.0774	–2.1570	–1.8535	670.86	<0.0001
	2013 SONATA 4D	1	–0.0681	–7%	0.0215	–0.1103	–0.0260	10.05	0.0015
	2013 TUCSON 4D 2WD	1	–1.2537	–71%	0.0706	–1.3920	–1.1154	315.76	<0.0001
	2013 TUCSON 4D 4WD	1	–1.3896	–75%	0.0930	–1.5719	–1.2073	223.22	<0.0001
	2013 VELOSTER 3D	1	–1.8015	–83%	0.1095	–2.0162	–1.5868	270.47	<0.0001
	2013 ELANTRA 4D	1	–0.3330	–28%	0.0199	–0.3720	–0.2941	280.90	<0.0001
	2014 ELANTRA GT 5D	1	–1.5038	–78%	0.1012	–1.7021	–1.3055	220.94	<0.0001
	2014 GENESIS COUPE 2D	1	–1.8520	–84%	0.3783	–2.5935	–1.1106	23.97	<0.0001
	2014 SANTA FE 4D 2WD	1	–0.9838	–63%	0.1967	–1.3694	–0.5982	25.00	<0.0001
	2014 SANTA FE 4D 4WD	1	–1.2611	–72%	0.2362	–1.7241	–0.7980	28.50	<0.0001
	2014 SANTA FE SPORT 4D 2WD	1	–1.9917	–86%	0.0747	–2.1382	–1.8452	710.07	<0.0001
	2014 SANTA FE SPORT 4D 4WD	1	–1.6184	–80%	0.0726	–1.7607	–1.4761	496.89	<0.0001
	2014 SONATA 4D	1	–0.0681	–7%	0.0256	–0.1183	–0.0179	7.06	0.0079
	2014 TUCSON 4D 2WD	1	–1.6273	–80%	0.0962	–1.8157	–1.4388	286.39	<0.0001
	2014 TUCSON 4D 4WD	1	–1.6458	–81%	0.1122	–1.8657	–1.4259	215.14	<0.0001
	2014 VELOSTER 3D	1	–1.6351	–81%	0.1482	–1.9256	–1.3445	121.67	<0.0001
	2014 VELOSTER TURBO 3D	1	–2.0750	–87%	0.5002	–3.0555	–1.0945	17.21	<0.0001
	2014 ELANTRA 4D	1	–0.3704	–31%	0.0264	–0.4222	–0.3186	196.32	<0.0001
	2015 ELANTRA GT 5D	1	–1.7575	–83%	0.2091	–2.1673	–1.3477	70.66	<0.0001
	2015 SANTA FE 4D 2WD	1	–1.5344	–78%	0.2587	–2.0414	–1.0275	35.19	<0.0001
	2015 SANTA FE 4D 4WD	1	–1.3952	–75%	0.2048	–1.7965	–0.9939	46.43	<0.0001

Table A1: Illustrative regression results — Hyundai theft claim frequency									
Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	*p* value
	2015 SANTA FE SPORT 4D 2WD	1	–1.1871	–69%	0.0850	–1.3537	–1.0204	194.82	<0.0001
	2015 SANTA FE SPORT 4D 4WD	1	–1.2682	–72%	0.0865	–1.4378	–1.0986	214.74	<0.0001
	2015 SONATA 4D	1	0.1172	12%	0.0219	0.0742	0.1602	28.57	<0.0001
	2015 TUCSON 4D 2WD	1	–1.3151	–73%	0.0745	–1.4612	–1.1690	311.24	<0.0001
	2015 TUCSON 4D 4WD	1	–1.4660	–77%	0.0813	–1.6253	–1.3066	325.03	<0.0001
	2015 VELOSTER 3D	1	–1.5829	–79%	0.1357	–1.8489	–1.3170	136.06	<0.0001
	2015 VELOSTER TURBO 3D	1	–1.9383	–86%	0.5002	–2.9187	–0.9578	15.01	0.0001
	2015 ELANTRA 4D	1	–0.3464	–29%	0.0246	–0.3945	–0.2982	198.84	<0.0001
	2016 ELANTRA GT 5D	1	–1.3436	–74%	0.0734	–1.4875	–1.1998	335.01	<0.0001
	2016 SANTA FE 4D 2WD	1	–1.4373	–76%	0.1864	–1.8025	–1.0720	59.48	<0.0001
	2016 SANTA FE 4D 4WD	1	–1.4984	–78%	0.1570	–1.8061	–1.1908	91.13	<0.0001
	2016 SANTA FE SPORT 4D 2WD	1	–1.2411	–71%	0.0757	–1.3895	–1.0927	268.57	<0.0001
	2016 SANTA FE SPORT 4D 4WD	1	–1.2207	–70%	0.0735	–1.3647	–1.0767	276.08	<0.0001
	2016 SONATA 4D	1	0.1498	16%	0.0224	0.1059	0.1937	44.66	<0.0001
	2016 TUCSON 4D 2WD	1	–0.2063	–19%	0.0367	–0.2783	–0.1343	31.55	<0.0001
	2016 TUCSON 4D 4WD	1	–0.1122	–11%	0.0412	–0.1930	–0.0313	7.40	0.0065
	2016 VELOSTER 3D	1	–1.5637	–79%	0.0911	–1.7423	–1.3852	294.60	<0.0001
	2016 VELOSTER TURBO 3D	1	–1.9316	–86%	0.2677	–2.4563	–1.4069	52.06	<0.0001
	2016 ELANTRA 4D	1	–0.2830	–25%	0.0233	–0.3286	–0.2373	147.69	<0.0001
	2018 ACCENT 4D	1	–1.0862	–66%	0.0697	–1.2228	–0.9495	242.61	<0.0001
	2018 ELANTRA GT 5D	1	–1.2552	–71%	0.0874	–1.4265	–1.0839	206.20	<0.0001
	2018 KONA 5D 2WD	1	–2.1204	–88%	0.2299	–2.5711	–1.6698	85.04	<0.0001
	2018 KONA 5D 4WD	1	–2.3266	–90%	0.2505	–2.8175	–1.8356	86.26	<0.0001
	2018 SANTA FE 4D 2WD	1	–1.3612	–74%	0.1499	–1.6550	–1.0674	82.47	<0.0001
	2018 SANTA FE 4D 4WD	1	–1.7699	–83%	0.2188	–2.1987	–1.3411	65.44	<0.0001
	2018 SANTA FE SPORT 4D 2WD	1	–1.1437	–68%	0.0627	–1.2666	–1.0209	332.97	<0.0001
	2018 SANTA FE SPORT 4D 4WD	1	–1.2780	–72%	0.0731	–1.4212	–1.1347	305.68	<0.0001
	2018 SONATA 4D	1	0.0403	4%	0.0298	–0.0181	0.0987	1.83	0.1758
	2018 TUCSON 4D 2WD	1	–0.1916	–17%	0.0363	–0.2627	–0.1205	27.91	<0.0001
	2018 TUCSON 4D 4WD	1	–0.0664	–6%	0.0300	–0.1253	–0.0076	4.89	0.0270
	2018 ELANTRA 4D	1	–0.0353	–3%	0.0210	–0.0765	0.0058	2.84	0.0921
	2019 ACCENT 4D	1	–1.0240	–64%	0.0531	–1.1280	–0.9200	372.18	<0.0001
	2019 ELANTRA GT 5D	1	–1.1102	–67%	0.1322	–1.3693	–0.8511	70.54	<0.0001
	2019 KONA 4D 2WD	1	–1.7724	–83%	0.0961	–1.9608	–1.5839	339.81	<0.0001
	2019 KONA 4D 4WD	1	–1.5859	–80%	0.0941	–1.7704	–1.4014	283.75	<0.0001
	2019 SANTA FE 4D 2WD	1	–1.4660	–77%	0.0759	–1.6148	–1.3172	372.74	<0.0001
	2019 SANTA FE 4D 4WD	1	–1.6536	–81%	0.0774	–1.8053	–1.5019	456.54	<0.0001
	2019 SANTA FE XL 4D 2WD	1	–1.5451	–79%	0.2891	–2.1117	–0.9784	28.56	<0.0001
	2019 SANTA FE XL 4D 4WD	1	–2.2094	–89%	0.4086	–3.0101	–1.4086	29.24	<0.0001
	2019 SONATA 4D	1	0.0652	7%	0.0290	0.0082	0.1221	5.03	0.0248
	2019 TUCSON 4D 2WD	1	–0.1992	–18%	0.0381	–0.2739	–0.1245	27.33	<0.0001
	2019 TUCSON 4D 4WD	1	–0.2263	–20%	0.0354	–0.2956	–0.1569	40.91	<0.0001
	2019 VELOSTER 3D	1	–1.4403	–76%	0.1345	–1.7039	–1.1767	114.65	<0.0001
	2019 ELANTRA 4D	1	–0.1211	–11%	0.0228	–0.1657	–0.0764	28.25	<0.0001
	2020 ACCENT 4D	1	–0.8118	–56%	0.0599	–0.9292	–0.6944	183.57	<0.0001

Table A1: Illustrative regression results — Hyundai theft claim frequency									
Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	*p* value
	2020 ELANTRA GT 5D	1	–1.2055	–70%	0.1931	–1.5839	–0.8271	38.99	<0.0001
	2020 KONA 4D 2WD	1	–1.5275	–78%	0.1059	–1.7352	–1.3198	207.86	<0.0001
	2020 KONA 4D 4WD	1	–1.8773	–85%	0.1499	–2.1711	–1.5835	156.87	<0.0001
	2020 PALISADE 4D 2WD	1	–2.3083	–90%	0.3783	–3.0498	–1.5669	37.23	<0.0001
	2020 PALISADE 4D 4WD	1	–2.3865	–91%	0.3539	–3.0801	–1.6929	45.47	<0.0001
	2020 SANTA FE 4D 2WD	1	–1.6508	–81%	0.1027	–1.8521	–1.4494	258.26	<0.0001
	2020 SANTA FE 4D 4WD	1	–1.7471	–83%	0.1122	–1.9670	–1.5272	242.41	<0.0001
	2020 TUCSON 4D 2WD	1	–0.1852	–17%	0.0549	–0.2929	–0.0776	11.37	0.0007
	2020 TUCSON 4D 4WD	1	–0.1875	–17%	0.0467	–0.2790	–0.0960	16.12	<0.0001
	2020 VELOSTER 3D	1	–1.6008	–80%	0.2241	–2.0401	–1.1615	51.01	<0.0001
	2020 VENUE 4D 2WD	1	–2.0277	–87%	0.1214	–2.2656	–1.7898	279.14	<0.0001
	2020 ELANTRA 4D	1	–0.1468	–14%	0.0220	–0.1899	–0.1037	44.59	<0.0001
	2021 ACCENT 4D	1	–0.9298	–61%	0.0727	–1.0723	–0.7873	163.56	<0.0001
	2021 KONA 4D 2WD	1	–1.2984	–73%	0.1129	–1.5197	–1.0772	132.33	<0.0001
	2021 KONA 4D 4WD	1	–1.7222	–82%	0.1301	–1.9771	–1.4673	175.32	<0.0001
	2021 PALISADE 4D 2WD	1	–2.4906	–92%	0.4086	–3.2913	–1.6898	37.16	<0.0001
	2021 PALISADE 4D 4WD	1	–2.0131	–87%	0.2891	–2.5797	–1.4464	48.48	<0.0001
	2021 SANTA FE 4D 2WD	1	–1.9791	–86%	0.2300	–2.4298	–1.5284	74.07	<0.0001
	2021 SANTA FE 4D 4WD	1	–1.7013	–82%	0.1832	–2.0604	–1.3421	86.20	<0.0001
	2021 TUCSON 4D 2WD	1	–0.1570	–15%	0.0607	–0.2760	–0.0379	6.68	0.0097
	2021 TUCSON 4D 4WD	1	–0.2445	–22%	0.0669	–0.3757	–0.1133	13.34	0.0003
	2021 VELOSTER 3D	1	–1.3283	–74%	0.7073	–2.7146	0.0580	3.53	0.0604
	2021 VENUE 4D 2WD	1	–2.0997	–88%	0.1143	–2.3237	–1.8757	337.62	<0.0001
	2021 ELANTRA 4D	1	–0.7403	–52%	0.0617	–0.8613	–0.6193	143.83	<0.0001
	2022 ACCENT 4D	1	–1.2378	–71%	0.2047	–1.6391	–0.8366	36.57	<0.0001
	2022 KONA 4D 2WD	1	–1.7094	–82%	0.2362	–2.1724	–1.2464	52.36	<0.0001
	2022 KONA 4D 4WD	1	–2.1679	–89%	0.2587	–2.6750	–1.6609	70.23	<0.0001
	2022 SANTA FE 4D 2WD	1	–1.3095	–73%	0.3539	–2.0031	–0.6158	13.69	0.0002
	2022 SANTA FE 4D 4WD	1	–1.6337	–80%	0.3337	–2.2878	–0.9797	23.97	<0.0001
	2022 TUCSON 4D 2WD	1	–1.5648	–79%	0.1967	–1.9504	–1.1792	63.26	<0.0001
	2022 TUCSON 4D 4WD	1	–1.9636	–86%	0.1967	–2.3492	–1.5780	99.60	<0.0001
	2022 ELANTRA 4D	1	–0.7306	–52%	0.1651	–1.0543	–0.4070	19.58	<0.0001
	2017 ELANTRA GT 5D	1	–1.3523	–74%	0.0983	–1.5450	–1.1596	189.14	<0.0001
	2017 SANTA FE 4D 2WD	1	–1.4330	–76%	0.1049	–1.6385	–1.2275	186.75	<0.0001
	2017 SANTA FE 4D 4WD	1	–1.6120	–80%	0.1077	–1.8231	–1.4008	223.82	<0.0001
	2017 SANTA FE SPORT 4D 2WD	1	–1.3237	–73%	0.0557	–1.4329	–1.2145	564.27	<0.0001
	2017 SANTA FE SPORT 4D 4WD	1	–1.2782	–72%	0.0523	–1.3807	–1.1757	597.28	<0.0001
	2017 SONATA 4D	1	0.1828	20%	0.0224	0.1388	0.2268	66.31	<0.0001
	2017 TUCSON 4D 2WD	1	–0.1704	–16%	0.0321	–0.2334	–0.1074	28.10	<0.0001
	2017 TUCSON 4D 4WD	1	–0.1325	–12%	0.0335	–0.1982	–0.0668	15.63	<0.0001
	2017 VELOSTER 3D	1	–1.4501	–77%	0.1369	–1.7185	–1.1817	112.12	<0.0001
	2017 VELOSTER TURBO 3D	1	–8.4096	–100%	19.5143	–46.6569	29.8376	0.19	0.6665
	2017 ELANTRA 4D	0	0	0	0	0	0	0	0
Anti-theft software		1	–0.6175	–46%	0.0092	–0.6355	–0.5995	4517.36	<0.0001

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