HIGHWAY LOSS DATA INSTITUTE

Bulletin | Vol. 29, No. 4 : April 2012

Motorcycle ABS and time to claim

Antilock braking systems (ABS) have previously been shown to reduce motorcycle collision claim frequencies. The current study examines how this effect varies, depending on the length of time a motorcycle has been insured. The study shows that ABS is associated with a 30 percent reduction in collision claim frequency during the first 90 days of a policy and 19 percent after that.

Introduction

The Highway Loss Data Institute (HLDI) initially reported on the effect of motorcycle antilock braking systems (ABS) on collision losses in April 2008 (Vol. 25, No.1). The analysis was updated in December 2009 to add medical payment and bodily injury liability coverages (A-81). Significant reductions in collision claim frequencies and overall losses were found in both reports for motorcycles equipped with ABS. The 2009 study also found significant reductions in claim frequency under bodily injury liability and medical payment coverages. Another 2008 HLDI bulletin examined the extent to which the risk of a collision claim is higher during the initial days of a policy (Vol. 25, No. 6). Results showed that collision claim frequencies during early ownership were higher than during later time periods, possibly due to riders' inexperience in general and/or inexperience with a new motorcycle. The purpose of this HLDI bulletin is to examine the effect of motorcycle ABS on collision coverage losses at various points during a policy.

Methods

Insurance data

Motorcycle insurance covers damage to vehicles and property as well as injuries to people involved in crashes. Different insurance coverages pay for physical damage versus injuries. Also, different coverages may apply depending on who is at fault. In the present study, collision coverage was examined. Collision insures against physical damage to a motorcycle sustained in a crash when the driver is at fault. Exposure is measured in insured vehicle years. An insured vehicle year is one vehicle insured for one year, two for six months, etc. Collision loss data for this study totaled 4,361 claims in 140,080 insured vehicle years.

Time to claim

Starting at the effective date of a policy, the total exposure time period, defined as days between a policy's effective date and its termination date, was limited to 720 days. Loss data beyond 720 days were not included in the analysis because the distribution of insured motorcycles begins to change after the first two years. This happens for a variety of reasons. For example, sport class motorcycles tend to have more total losses than other classes. Additionally, many riders choose to drop collision coverage once their loans are paid off. The total time period or policy length was divided into five segments: 1-90 days, 91-180 days, 181-270 days, 271-360 days, and 361-720 days.

Motorcycles

For motorcycles to be included in the study, their vehicle identification numbers (VINs) had to have an ABS indicator. This allowed for tight control over the study population. Only 2006-10 model year motorcycles with optional ABS were included. This restriction produced 32 motorcycle series.

Motorcycle classes included scooter, cruiser, chopper, touring, dual purpose, standard, sport touring, unclad sport, sport, and super sport. Since loss data for some classes were limited, sport touring was grouped with touring. Unclad sport, sport, and super sport were grouped into a sports category. Scooter, chopper, dual purpose, and standard formed the "other" group. Vehicle age status was created to indicate whether a motorcycle was new at the inception of the policy. Vehicle age status was calculated by taking the difference between the motorcycle model year and the calendar year the insurance policy was effective. A motorcycle was considered new if the difference was zero (model year and calendar year are equal) or -1 (model year was one year before calendar year).

Rated drivers (riders)

For insurance purposes, a rated driver is assigned to each motorcycle on a policy. The rated driver is the one who typically is considered to represent the greatest loss potential for the insured vehicle. In a household with multiple vehicles and/or drivers, the assignment of drivers to vehicles can vary by insurance company and by state, but usually it reflects the driver most likely to operate the vehicle. Information on the actual driver at the time of a loss is not available in the HLDI database. For this study, data were stratified by rated driver age group: 14-20, 21-35, 36-50, 51-65, and 66+. Driver age was defined as the difference between the insured driver's year of birth and the year of the policy's effective date.

Geographic factors

Geographic characteristics included registered vehicle density and garaging state. Registered vehicle density was defined as the number of registered vehicles per square mile (<100, 100-499, and 500+) in the relevant zip code area. State was used in the analysis to control for its potential impacts on losses, such as state-specific liability limits or economic variation.

Statistical methods

In each of the five time periods, the effect of ABS was estimated by calculating the claim frequency difference between the ABS- and non-ABS-equipped groups. The corresponding 95 percent confidence interval for each difference was produced using asymptotic normal approximation. In instances where the confidence intervals for any time period overlapped with another time period, the results were considered similar.

Regression analysis was used to quantify the effect of ABS on motorcycle collision claim frequency by time period while controlling for other covariates. Frequency was modeled using Poisson regression with a logarithmic link function. The dataset was stratified by motorcycle class, model year, vehicle age status, rated driver age, vehicle density and state. For example, a unit of observation was a 51-65-year-old driver riding a model year 2008 not new touring motorcycle in an area of California with a vehicle density of more than 500 vehicles per square mile. All these covariates were modeled as categorical variables, and typically the reference category had the highest exposure.

The interaction of ABS and time period was used in the model to estimate the effectiveness of ABS. Two time periods were ultimately used: 1-90 days and 91-720 days.

Results

Figure 1 compares collision claim frequencies, measured in claims per 100 insured vehicle years, between the with and without ABS groups in each of the five time periods. The ABS motorcycles consistently had lower claim frequencies than the non-ABS bikes. The claim frequency trend for with ABS group was nearly parallel to that for the non-ABS group in the last 4 time periods.

Figure 1: Collision claims frequencies by ABS availability and time periods, 2006-10 motorcycles

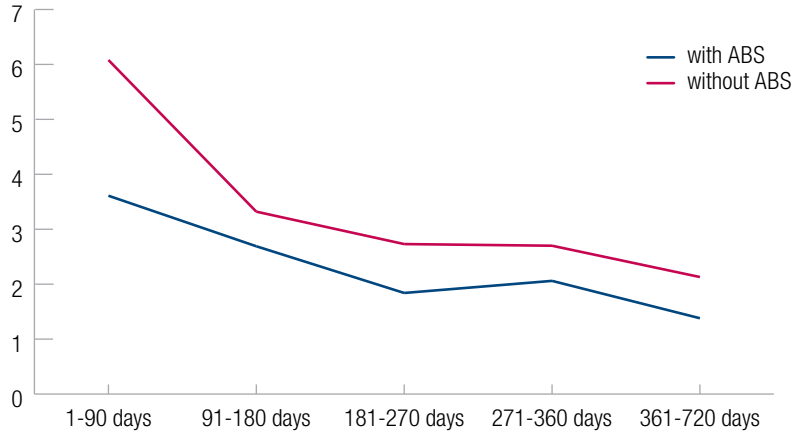


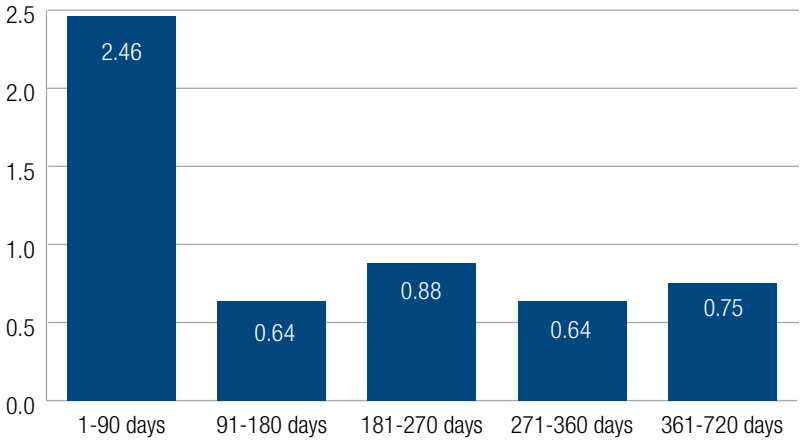
Table 1 lists collision exposure, claims and claim frequencies for the group with ABS and the group without by time period. Although the 1-90-day time period accounted for only one eighth of the total days studied, it accounted for 35 percent of claims and 22 percent of exposure for motorcycles with ABS, and 40 percent of claims and 22 percent of exposure for motorcycles without ABS. In contrast, the 361-720-day time period accounted for half of the total time period, but 19 percent of claims and 32 percent of exposure for motorcycles with ABS, and 19 percent of claims and 31 percent of exposure for motorcycles without ABS.

Table 1: Claim and exposure distribution by ABS availability and time period, 2006-10 motorcycles

	Time period (days)				
ABS availability	1-90	91-180	181-270	271-360	361-720
Exposure					
With ABS	7,718	6,362	5,366	4,702	11,165
Without ABS	23,548	19,012	15,843	13,762	32,601
Claims					
With ABS	279	171	99	97	154
Without ABS	1,431	632	432	372	694
Claim frequency					
With ABS	3.61	2.69	1.84	2.06	1.38
Without ABS	6.08	3.32	2.73	2.70	2.13

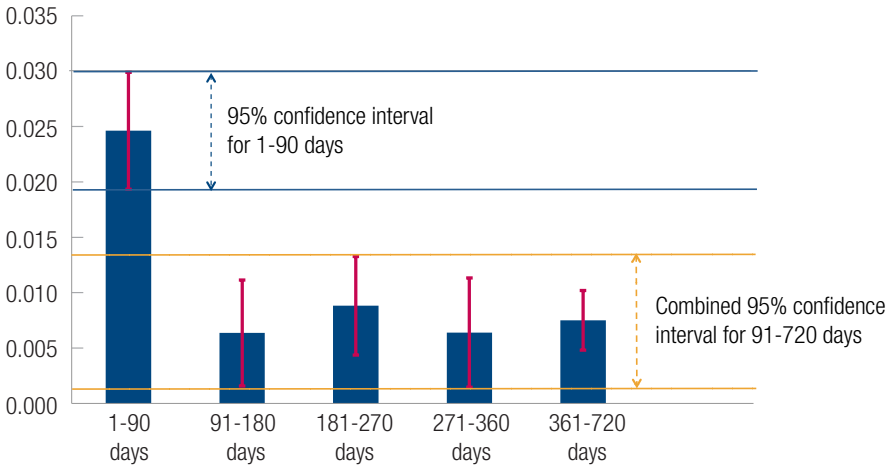
Figure 2 shows the collision claim frequency difference between the motorcycles with ABS and those without in each time period. The difference in the first 90 days was 3.9 times that of the second 90 days, 2.8 times that of the third 90 days, 3.8 times that of the fourth 90 days, and 3.3 times that of the final 360 days.

Figure 2: Collision claim frequency for non-ABS and ABS motorcycles by time period, 2006-10 models



The effect of ABS was measured by the claim frequency differences between motorcycles with ABS and those without. Figure 3 illustrates the 95 percent confidence intervals for the collision claim frequency differences for each time period. The upper and lower 95 percent confidence boundaries of the frequency difference for the first time period are marked by two parallel blue lines. The 95 percent confidence intervals of the other four time periods overlap each other, indicating these four differences are not significantly different. A compound 95 percent confidence interval was formed by combining the four separate 95 percent confidence intervals and is marked by two parallel orange lines. The 95 percent confidence interval for the first 90 days (blue dashed arrow), does not overlap the compound 95 percent confidence interval (orange dashed arrow) for the four other time periods, indicating the effect of ABS is different for the first time period from of the effect for the other time periods.

Figure 3: Collision claim frequency difference between non-ABS and ABS motorcycles by time period, 2006-10 models



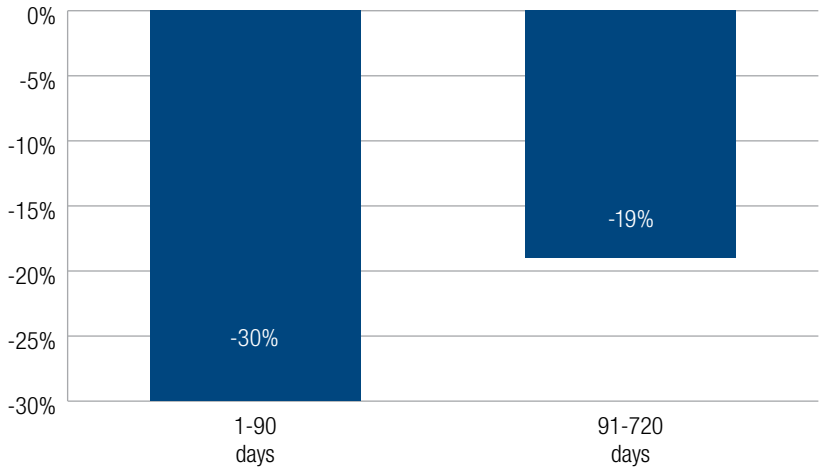
Based upon the results shown in Figure 3, the last four time periods were merged to form a new time period that covered 91-720 days. Poisson regression was implemented to see whether the ABS effect in 1-90 days was different from that in 91-720 days. Summary results of the regression analysis of collision claim frequencies using the Poisson distribution are listed in Table 2. Results for all independent variables had p-values less than 0.05, indicating their effects on claim frequencies were statistically significant. The interaction of ABS by time period was highly significant.

Table 2 : Summary results of linear regression analysis of collision claim frequencies

	Degree of freedom	Chi-square	P-value
ABS * time period	3	583.25	<0.0001
Motorcycle class	3	240.98	<0.0002
Model year	4	55.48	<0.0003
Vehicle age	1	29.51	<0.0004
Rated driver age	5	180.66	<0.0005
Vehicle density	2	41.11	<0.0006
State	50	178.67	<0.0007

Figure 4 shows the estimated effect of ABS on collision claim frequencies in the two time periods. Within the first 90 days of exposure, collision claim frequency for motorcycles with ABS was estimated to be 30 percent lower than frequency for motorcycles without ABS. In the time period between 91 days and 720 days of policy exposure, motorcycles with ABS were estimated to have a claim frequency 19 percent lower than that of motorcycles without ABS. The effect of ABS in the first time period was much higher than in the second time period.

Figure 4: Estimated effect of ABS on collision claim frequency by time period, 2006-10 motorcycles



Detailed results of the regression analysis using claim frequency as the dependent variable are listed in Table 3. States are listed in ascending order from the lowest estimate to the highest. The estimate for motorcycles with ABS corresponded to a significant 30 percent decrease in collision claims compared with motorcycles without ABS in the first 90 days and a significant 19 percent decrease in days 91-720.

Collision claim frequencies for the cruiser, others, and sports groups were estimated to be 25 percent higher, 22 percent higher, and 112 percent higher than that of touring motorcycles; all estimates except for cruisers were significant. Estimated collision claim frequency for 2009 models was significantly higher (27 percent) than 2008 models. New motorcycles were estimated to have a claim frequency 19 percent higher than older ones, a significant result.

Rated driver age was a significant predictor of claim frequency. Compared with riders 51-65 years old, estimated collision claim frequency for riders under 21, young adults and seniors was 255 percent higher, 52 percent higher, and 17 percent higher, respectively.

Compared with losses in high-vehicle-density areas, estimated claim frequency was significantly lower (24 percent) in low-vehicle-density areas, and in medium-vehicle-density areas (9 percent). Compared with California, significant collision claim frequency estimates ranged from 58 percent lower for Massachusetts to 19 percent lower for Tennessee.

Table 3 : Detailed results of linear regression analysis of collision claim frequencies

Parameter	Estimate	Exponent estimate	Standard error	Chi-square	P-value
Intercept	-8.8046	1.50E-04	0.0677	16,892.10	<0.0001
ABS * time period					
ABS, 1-90 day	-0.3535	0.7022	0.0667	28.10	<0.0001
No ABS, 1-90 day	0	1	0		
Abs 91-720 day	-0.9914	0.3711	0.0532	347.48	<0.0001
No ABS, 91-720 day	-0.7820	0.4575	0.0347	508.90	<0.0001
Motorcycle class					
Cruiser	0.2207	1.2469	0.1139	3.75	0.0527
Other	0.1965	1.2171	0.0416	22.29	<0.0001
Sport	0.7535	2.1244	0.0480	246.76	<0.0001
Touring	0	1	0		
Model year					
2006	-0.0570	0.9446	0.0473	1.45	0.2280
2007	-0.0770	0.9259	0.0448	2.95	0.0860
2008	0	1	0		
2009	0.2376	1.2682	0.0456	27.15	<0.0001
2010	-0.0223	0.9779	0.0687	0.11	0.7455
Vehicle age status					
New	0.1737	1.1897	0.0319	29.63	<0.0001
Not new	0	1	0		
Rated driver age					
14-20	1.2668	3.5495	0.0983	166.17	<0.0001
21-35	0.4178	1.5186	0.0505	68.49	<0.0001
36-50	0.0380	1.0387	0.0403	0.89	0.3464
51-65	0	1	0		
66+	0.1594	1.1728	0.0624	6.53	0.0106
Unknown	0.2743	1.3156	0.0777	12.46	0.0004
Vehicle density					
0-99	-0.2803	0.7556	0.0444	39.90	<0.0001
100-499	-0.0987	0.9060	0.0369	7.16	0.0075
500+	0	1	0		
State					
Massachusetts	-0.8776	0.4158	0.1391	39.81	<0.0001
Delaware	-0.6801	0.5066	0.3804	3.20	0.0738
South Carolina	-0.6592	0.5173	0.1645	16.05	<0.0001
Rhode Island	-0.6389	0.5279	0.5791	1.22	0.2700

Table 3 : Detailed results of linear regression analysis of collision claim frequencies					
Parameter	Estimate	Exponent estimate	Standard error	Chi-square	P-value
Minnesota	-0.6161	0.5400	0.1119	30.30	<0.0001
Wisconsin	-0.5977	0.5501	0.1136	27.66	<0.0001
West Virginia	-0.5887	0.5550	0.2014	8.54	0.0035
Iowa	-0.5876	0.5557	0.1644	12.78	0.0004
Oklahoma	-0.5730	0.5638	0.1251	20.96	<0.0001
Kentucky	-0.5728	0.5639	0.1820	9.91	0.0016
Idaho	-0.5550	0.5741	0.2282	5.92	0.0150
North Carolina	-0.4940	0.6102	0.1146	18.58	<0.0001
Colorado	-0.4698	0.6251	0.1077	19.02	<0.0001
Missouri	-0.4688	0.6258	0.1167	16.15	<0.0001
Nevada	-0.4664	0.6273	0.2011	5.38	0.0204
Pennsylvania	-0.4478	0.6390	0.0950	22.22	<0.0001
Ohio	-0.4232	0.6549	0.0949	19.90	<0.0001
Maine	-0.4230	0.6551	0.2810	2.27	0.1322
Utah	-0.4003	0.6701	0.1536	6.79	0.0091
Alaska	-0.3980	0.6717	0.2922	1.86	0.1732
Illinois	-0.3973	0.6721	0.0853	21.72	<0.0001
Oregon	-0.3963	0.6728	0.1256	9.96	0.0016
New Jersey	-0.3940	0.6744	0.1426	7.63	0.0057
Virginia	-0.3859	0.6798	0.1017	14.39	0.0001
Wyoming	-0.3834	0.6815	0.2935	1.71	0.1915
Kansas	-0.3762	0.6865	0.1427	6.95	0.0084
Indiana	-0.3395	0.7121	0.1164	8.51	0.0035
Hawaii	-0.3290	0.7196	0.2093	2.47	0.1161
Alabama	-0.3154	0.7295	0.1230	6.57	0.0104
North Dakota	-0.3083	0.7347	0.2825	1.19	0.2752
Montana	-0.3024	0.7390	0.2725	1.23	0.2671
South Dakota	-0.2912	0.7474	0.2549	1.31	0.2533
New York	-0.2694	0.7638	0.1017	7.01	0.0081
Florida	-0.2682	0.7648	0.0694	14.92	0.0001
Vermont	-0.2571	0.7733	0.3195	0.65	0.4210
Connecticut	-0.2415	0.7854	0.1656	2.13	0.1448
Washington	-0.2388	0.7876	0.0927	6.63	0.0100
New Mexico	-0.2257	0.7980	0.1450	2.42	0.1195
Arizona	-0.2183	0.8039	0.1097	3.96	0.0466
Tennessee	-0.2084	0.8119	0.0979	4.53	0.0333
Michigan	-0.1597	0.8524	0.1085	2.17	0.1409
Maryland	-0.1532	0.8580	0.1181	1.68	0.1946
Nebraska	-0.1433	0.8665	0.1745	0.67	0.4114
Texas	-0.1174	0.8892	0.0698	2.83	0.0927
Georgia	-0.0920	0.9121	0.0864	1.14	0.2865
Mississippi	-0.0905	0.9135	0.1562	0.34	0.5624
Louisiana	-0.0146	0.9855	0.1178	0.02	0.9011
California	0	1	0		
New Hampshire	0.0102	1.0103	0.1944	0	0.9582
Arkansas	0.0264	1.0268	0.1240	0.05	0.8313
District of Columbia	0.0623	1.0643	0.3565	0.03	0.8613

Discussion

ABS is beneficial across the length of policies. The benefit is highest during the earliest days of the policy. Within the first 90 days, the collision claim frequency for motorcycles with ABS was estimated to be 30 percent lower than for motorcycles without ABS. In the later days of a policy the effect decreases. From 91 days to 720 days of policy, the effect of ABS was 19 percent. These results show that ABS helps eliminate some of the elevated risk that exists early in a policy period as documented in the 2008 bulletin on time to claim. Beyond 90 days, the effect of ABS on collision claim frequency is similar to the effect reported in earlier HLDI bulletins about motorcycle ABS.

It's not clear why ABS has a greater effect on collision claim frequencies early in a policy period. A plausible explanation relates to the possibility that new insurance policies represent either new and inexperienced riders or new rider/motorcycle combinations. These possibilities would suggest that high claim frequencies early in a policy period are due to inexperience or unfamiliarity with a particular bike and that ABS can help mitigate the consequences of rider mistakes that occur due to these conditions. The lower, but still large, frequency reductions later in the policy could be a result of experienced drivers making fewer of the kinds of errors ABS is best able to mitigate. While this is a plausible explanation for the observed results, the fact that the HLDI database does not include information about rider experience prevents this possibility from being further explored.

Limitations

Prior HLDI studies have documented a seasonal pattern to insurance claims for motorcycles. Claim rates are highest in warm-weather months and drop significantly during cold-weather months. This study does not adjust for seasonality. An evaluation of the effective dates of the policies shows that most the policies in this study take effect during the warm-weather months. However, a look at **Figure 1** in this study or **Figure 2** in the 2008 study reveals that the although claim frequencies do increase during the later time periods in the first year they do not reach the high levels exhibited in the earliest time periods. Additionally, the method by which rider age is calculated was unique to this study. The year of birth and policy year were subtracted to estimate driver age. It is possible that a driver had a December 31, 1980, birthday and a January 1, 2000, policy date. In this study the driver would be treated as a 20 year-old (2000-1980) but in reality the driver would have been 19 years old.

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