Auto Loss Costs: Comprehensive

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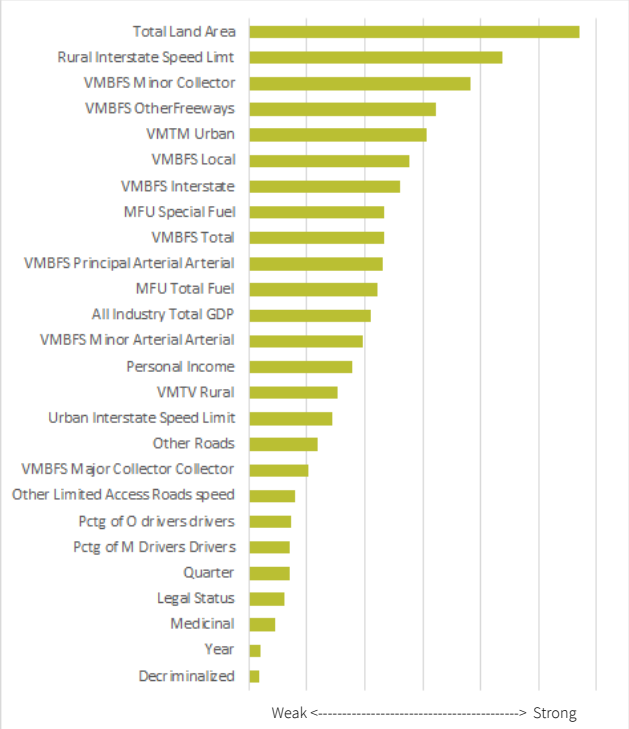
Increases in hailstorms, low- to zero-deductible windshield coverage, and large amounts of burnt acreage per state possibly explain increases in comprehensive frequency. States prone to extreme weather, and states with low-deductible coverage for windshield damage see higher levels of comprehensive severity. Comprehensive loss costs, like frequency and severity, seem to be driven by weather.

Figure 1
Frequency Variable Importance



Introduction

Comprehensive insurance covers theft and any vehicle damage not caused by a collision, but rather by natural causes or those of pure happenstance.

Comprehensive Frequency

In order to determine which explanatory variables impacted comprehensive claim frequency, a random forest model was run to determine variable importance. According to the variable importance plot shown in Figure 1, total land area is the best predictor of comprehensive frequency. Western states have more total land area than eastern ones and have a higher comprehensive frequency in general. This could be due to the difference in weather. The next few paragraphs will explore the impact of various weather conditions on comprehensive frequency.

One weather condition that affects comprehensive frequency is hail storms. During the spring and summer quarters, comprehensive frequency is higher than in the fall and winter because most hail storms occur in the spring and summer months, from May through September (Figure 2). States like Colorado, Arizona, and Texas are more prone to hail and thus have higher comprehensive frequencies than other states. Due to several severe hail storms during 2010 and 2011, states prone to hail reported unusually high comprehensive frequencies.

Some states in the U.S. require low- or no-deductible windshield replacement (Kentucky, Florida, Arizona, Massachusetts, New York, and South Carolina). Figure 3 is a graph of frequency for these states compared to the rest of the US. The blue line in figure 3 represents states offering low- or zero-deductible windshield replacement while the orange line represents all other states. We can see that the states offering low- or no-deductible windshield replacement have higher comprehensive frequency. Arizona has the highest frequency by far (see the map in Figure 4), but even without including Arizona, the hail states still have much higher frequency in quarters 2 and 3.

Figure 2
Hail States v Non-Hail States Frequency

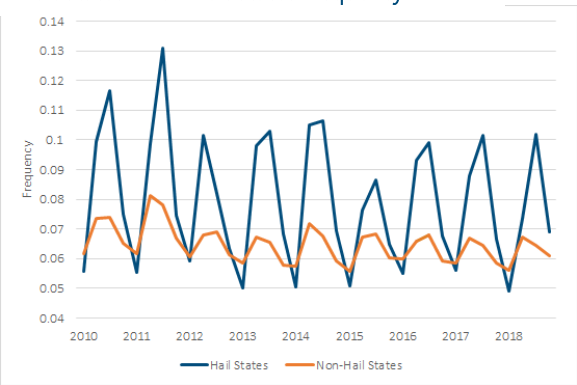
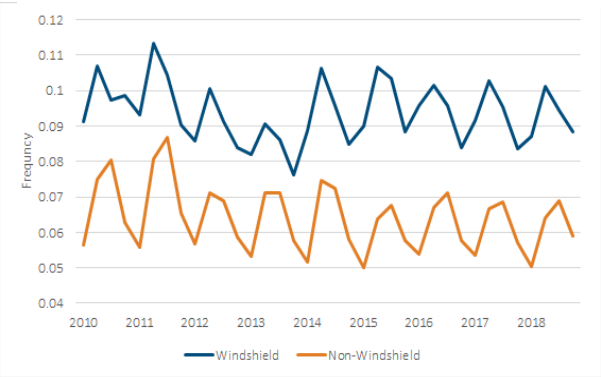


Figure 3
Windshield States v Non-Windshield States Frequency



Another weather condition affecting claim frequency is tornados. Claim frequency in states with high-risk of tornadoes saw trends like those in states with a high risk of hail. As shown in Figure 5, there were dramatic spikes in frequency during tornado season (second and third quarters) as well as reported frequency well above that of low-risk tornado states. Conversely, during the quarters not in tornado season (first and fourth), high-risk tornado states saw frequency consistently below that of low-risk tornado states.

Figure 4
Frequency Map

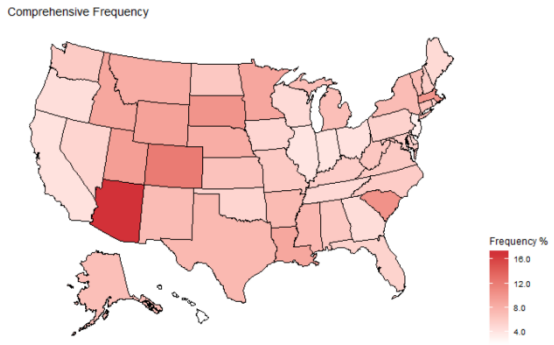
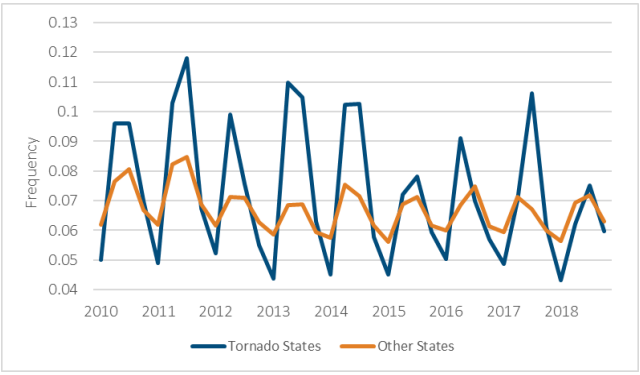


Figure 5
Tornado States Frequency



Fires also impact claim frequency. In general, the top ten states with wildfires and the top ten states for burnt acreage report higher average comprehensive frequencies than other states (see Figures 6 and 7). For the wildfire states, the huge jump in comprehensive frequency for the “Other States” in 2012 was due to the Colorado wildfires. As for burnt acreage, a measure of the number of acres burned, 2011 proved to be a very dry year for several states and 2012 was the warmest year on record since 1895. These conditions resulted in an increase of burnt acreage and also comprehensive frequency for all states. Frequency may increase in states with high burnt acreage because the fires can be near roads and homes causing comprehensive claims (ex. The 2018 Carr fire - a flat tire caused sparks to fly from the rim, igniting a fire that burned about 230,000 acres of land in California).

Figure 6
Burnt Acreage Frequency

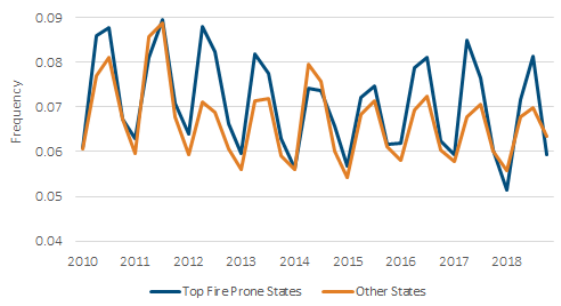


Figure 7
Wildfire States v Non-Wildfire States Frequency

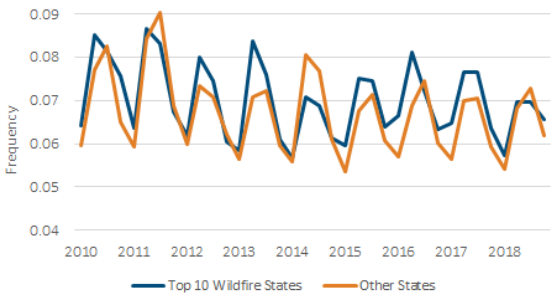
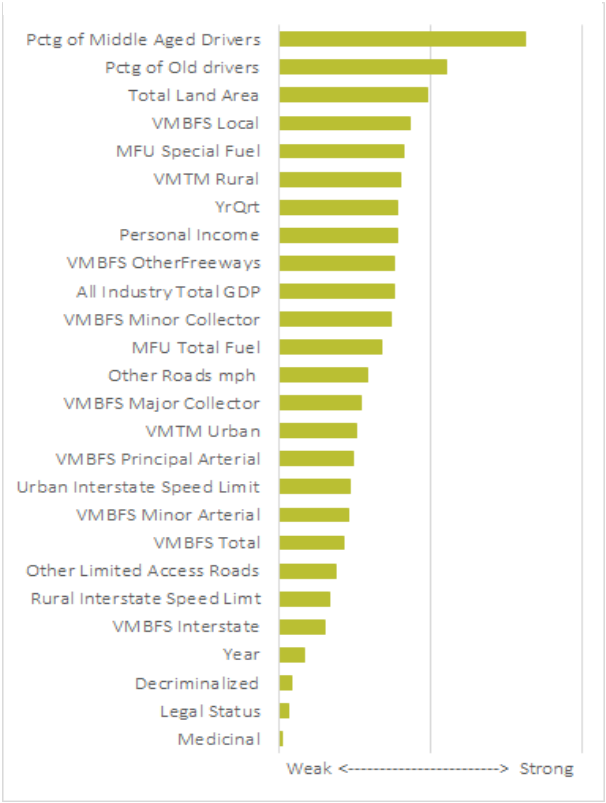


Figure 8
Severity Variable Importance

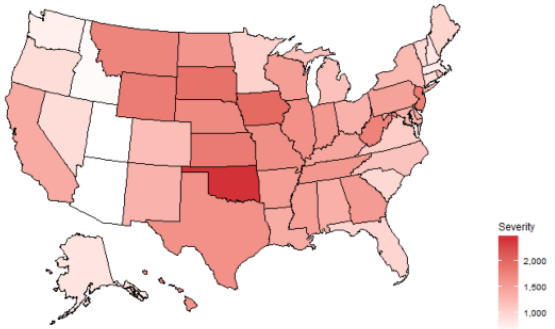


Comprehensive Severity

Our results (figure 8) show that the percentage of middle-aged drivers is the most important explanatory variable. Comparing severity to middle-aged drivers, we see a correlation of -0.23. This variable might have a strong variable importance due to the low severity in Arizona. Arizona has a low severity, but a high percentage of middle-aged drivers. However, we see that Utah, another state with low severity, has a very low percentage of middle-aged drivers. Therefore, this variable might not be highly effective in creating estimates for severity.

From the variable importance chart, the legalization of marijuana does not have an impact on comprehensive severity, as the three explanatory variables concerning legalization have the weakest impact on severity.

Figure 9
Average Severity



The comprehensive severity by each U.S. state is shown in Figure 9, where darker colors represent a higher severity. Differences between the lowest severity states (AZ, UT, ID) and the highest states (OK, IA, SD) may be due to exposure to hail and other severe weather.

While the frequency was higher for states with low- or no-deductible windshield replacement, the severity was inversely impacted (see Figure 10). Because the windshield replacement is frequent but cheap, the severity is much lower for zero-deductible windshield replacement states than for all other states. We see that in 2012 there is a large jump in states with zero-deductible windshield policies. This is due to an extremely large natural disaster in one of the few states in the low-deductible group (Hurricane Sandy, New York).

Figure 10
Windshield States v Non-Windshield States Severity

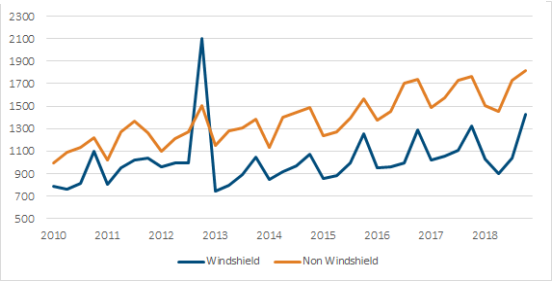


Figure 11
Hail State Severity

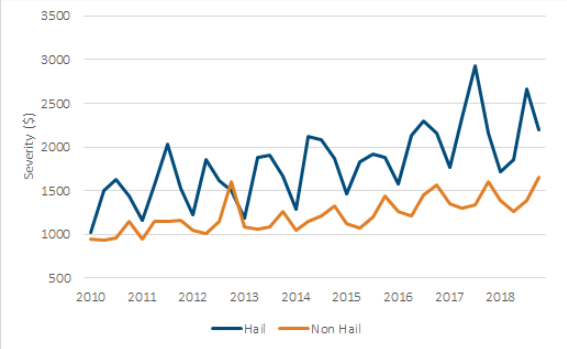
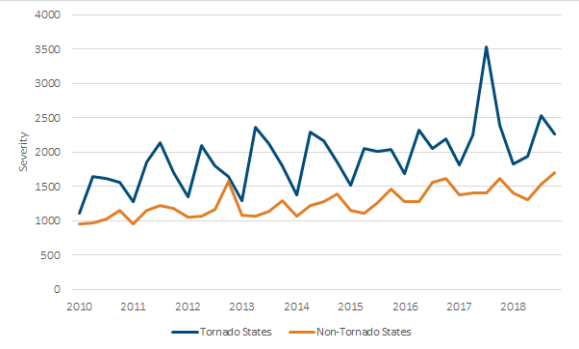


Figure 12
Tornado State Severity



Weather patterns also affect comprehensive severity. Severity for all states, especially those prone to hail, has generally increased. The last two jumps for the hail states include a few severe hailstorms in 2017 and 2018 in Colorado and Minnesota, each resulting in over 2 billion dollars in damage (Figure 11).

In addition to hail, tornados have an impact on severity. In a graph of the tornado- and non-tornado-prone state's severity over time (Figure 12), it is shown that high-risk tornado states have higher severity than low-risk tornado states. Since it is consistently higher and because we did not see similar results with frequency, this hints at possible lurking variables affecting severity in states with a high risk of tornados.

Comprehensive Loss Cost

Figure 13
State Loss Cost U.S. Map

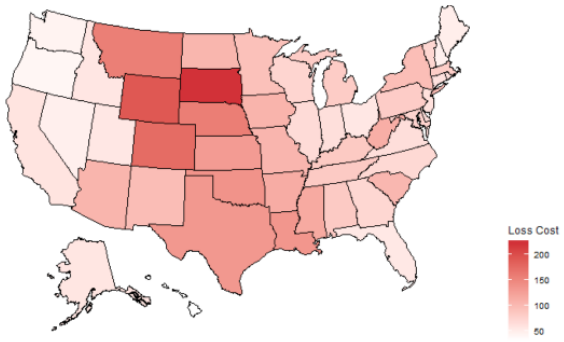
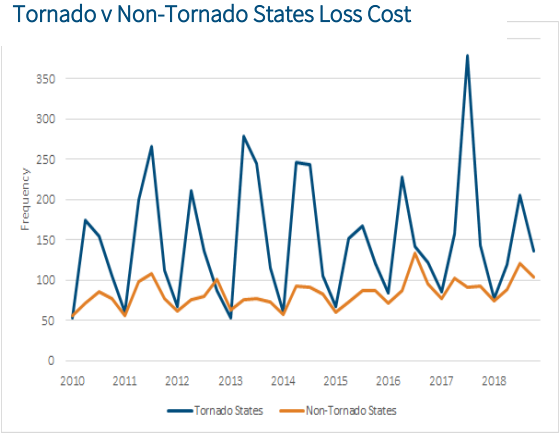


Figure 14
Tornado v Non-Tornado States Loss Cost



States with the highest loss costs are in the Midwest (Figure 13), possibly due to their high risk for natural disasters. The impact of tornados on loss cost is significant. High-risk tornado states show a very dramatic loss cost trend per quarter when compared to low-risk tornado states' loss costs (Figure 14). It is interesting to note that there are large differences between the high-risk states and the low-risk states during the second and third quarters (spring and summer) during tornado season, but small differences in the first and fourth quarters (fall and winter).

Conclusion

Increases in hailstorms, low- to zero-deductible windshield coverage, and large amounts of burnt acreage per state possibly explain increases in comprehensive frequency. States prone to extreme weather, and states with low-deductible coverage for windshield damage see higher levels of comprehensive severity. Comprehensive loss costs, like frequency and severity, seem to be driven by weather.