HIGHWAY LOSS DATA INSTITUTE

Bulletin | Vol. 30, No. 17 : September 2013

Evaluation of changes in teenage driver exposure

Reports have shown that fewer teenagers have been getting licensed. Consistent with those reports, the level of insured teenagers has declined between 2006 and 2012. Results suggest that a key factor in the decline has been the recession and the extremely high levels of teen unemployment. Graduated driver licensing laws were shown not to have had a large impact on the recent decline.

Introduction

Recent research has shown that the number of teens getting licensed has been on the decline. Studies by Sivak and Schoettle (2011, 2012a) found that in 2010, only 28 percent of 16 year-olds had a driver's license, down from 31 percent in 2008 and 46 percent in 1983. Licensed 17 year-olds were down to 46 percent in 2010 from 50 percent in 2008 and 69 percent in 1983. These results are obtained from annual state-by-state counts of driver licenses by age provided by the Federal Highway Administration (FHWA). However, examination of the data reveals large year-to-year fluctuations in a number of states in licensed driver counts for 16 year-olds, the minimum age of licensure in most states (Foss, 2013; Insurance Institute for Highway Safety, 2006). Cross-state differences reflect in part differences in how licensed drivers are defined, although the nature and extent of these differences are unknown. Within-state differences over time cannot be explained by fluctuations in population or changes in state licensing laws.

Another study by Davis et al. (2012) obtained similar results that young people are driving fewer miles and fewer are getting licensed. However, this study also relied on the flawed FHWA licensure data. Due to limitations with the FHWA data, Shults and Williams (2013) used data from annual surveys of high school students (Bachman et al., 2011) in order to estimate licensure and driving rates amongst high school seniors from 1996-2010. Their results confirmed that licensure rates for teenagers have declined and that fewer high school seniors are routinely driving. They also found that much of the decline has occurred since 2006. However, their data are based on self-administered surveys which have potential limitations as well (Bachman et al., 2006 and Fan et al., 2006). These limitations highlight the importance of this new study using independent data to corroborate the recent trends observed in teen licensure.

The results of these studies have led to much speculation as to the nature of the cause of the decline in teen licensure. Some media reports suggest the rise of social media, smartphones, and the internet as the primary reason. They claim that teens are less interested in driving, instead turning to Facebook or Twitter to interact with friends. University of Michigan Transportation Research Institute research professor Michael Sivak, postulated that, "It is possible that the availability of virtual contact through electronic means reduces the need for actual contact among young people" (Gorzelany, 2012). Further research by Sivak and Schoettle (2012b) found that a higher proportion of internet users were associated with a lower licensure rate in a regression analysis on young drivers in 15 countries.

However, in a more recent survey by Schoettle and Sivak (2013), only 3 percent of 18-19 year-olds chose "Able to communicate and/or conduct business online instead" as their main reason for not currently having a driver's license. The authors speculated that high internet usage may be a consequence, instead of a cause, of not having a driver's license and being readily able to drive. The top primary reason was "Too busy or not enough time to get a driver's license," with 38 percent of 18-19 year-olds choosing this response. Second on the list was "Owning and maintaining a vehicle is too expensive," chosen by 17 percent of the respondents as the primary reason. Similar surveys done by the Allstate Foundation (Williams, 2011) and the AAA Foundation for Traffic Safety (Tefft et al., 2013) found that teens wait to get licensed primarily for practical or economic reasons.

These results are consistent with other reports positing that it is the economy, not a preference for smartphones or other technology, that is keeping young people from driving. General Motors Company's chief economist Mustafa Mohaterem said "I don't see any evidence that the young people are losing interest in cars." Instead the recession, high teen unemployment, and rising costs of owning and driving a car are believed to be driving this trend (Burden et al., 2013). According to AAA's yearly publication, Your Driving Costs, the composite average cost per mile of driving a sedan 10,000 miles was $0.62 in 2006. By 2012, this cost had risen to $0.77 per mile, an increase of more than 24 percent (AAA, 2006, 2012). With teenage unemployment reaching as high as 26 percent in 2010, it may be that teenagers still want to drive and own cars, but they just cannot afford it.

Stricter licensing laws also have made the process of obtaining a license more difficult in addition to delaying the minimum age of full licensure in some states. Some teens say they are waiting until they are 18 to get a license in order to avoid the additional restrictions and costs imposed by graduated driver licensing laws (Halsey, 2013). Also many states require driver education for license applicants younger than 18 even though it is not always available in the public school system. The cost of private driver education programs may provide a disincentive for early licensing. However, the AAA Foundation for Traffic Safety survey found "little evidence that GDL was itself a major reason or motivator for delaying licensure." They observed that many teens not licensed before age 18 were still not licensed when they were 19 or 20, which suggests that most were not simply waiting out the GDL restrictions.

Davis et al. (2012) suggest a host of reasons for the decline including "higher gas prices, new licensing laws, improvements in technology that support alternative transportation, and changes in Generation Y's values and preferences." They found that the recession played a role in reducing the amount of miles driven by young people, but suggested that the trend towards reduced driving likely will persist after the economy rebounds due to fundamental shifts in young peoples' preferences towards protecting the environment and public transportation.

These prior studies all have focused on the number of licensed teens or vehicle-miles traveled. In addition, the data used in these studies have serious potential flaws or limitations. The purpose of this Highway Loss Data Institute (HLDI) bulletin is to investigate how these recent trends have affected the number of insured teen drivers and to examine the relationship between the level of insured teen drivers with the unemployment rate and graduated driver licensing laws.

Methods

External data

Population counts by age and state for the years 2006-2012 were obtained from the U.S. Census Bureau. Data for years 2006-2009 and 2010-2012 were projections based on the 2000 and 2010 censuses, respectively.

National and state unemployment data for ages 16-19, 35-44, and 45-54 were obtained from the Bureau of Labor Statistics. Unemployment data for people younger than 16 were unavailable. The unemployment rate for the 35-54 age group was calculated by combining the data for the 35-44 and 45-54 age groups and dividing the total number of unemployed by the combined civilian labor force.

Insurance data

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 coverage insures against vehicle damage to an at-fault driver's vehicle sustained in a crash with an object or other vehicle; this coverage is common to all 50 states. The main analysis was based on collision exposure for 0 to 9-year-old passenger vehicles during calendar years 2006-2012. Exposure is the amount of time an individual vehicle is insured. Forty-nine states and the District of Columbia were included. Massachusetts was excluded due to incomplete data. The combination of 50 jurisdictions and seven calendar years produced 350 observations. 2006 was chosen as the start date for this study as it was the first year with sufficient data on rated driver ages. Only data from insurers that consistently reported rated driver ages for all of 2006-2012 were included.

Rated drivers

Two rated driver age groups were used for this study: teenagers (14-19) and prime age drivers (35-54). 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. Because only the year of birth is provided to HLDI, the exact age of the rated driver is unknown. A January 1 birth date was assumed, resulting in a two-year range in the actual age for a given rated driver age. For example, the assigned age of 16 in this study can range from an actual age of 15 and 1 day to 16 and 364 days.

State GDL laws

Graduated driver licensing (GDL) laws are designed to delay full licensing while allowing beginning drivers to gain experience under lower-risk conditions. Six of the most common GDL provisions are examined in this study: learner's permit age, intermediate licensing age, learner's permit holding period, required practice driving, restrictions on night driving and restrictions on the number of passengers. Driver education is not examined because GDL requirements were added to pre-existing licensing requirements that included driver education in several states, but not in others. Those states that did not require driver education did not routinely add it as a requirement when they enacted GDL provisions.

In order to maintain consistency with the prior HLDI report on GDL, [April 2009 Insurance Special Report (A-79)] all of the GDL study variables except passenger restrictions were treated as continuous. The passenger restriction was coded into two groups: those laws that allow no passengers or one passenger and those that allow two or more passengers (including those with no restriction). The nighttime driving restriction was measured as the number of restricted hours, with 5 a.m. set as the morning cutoff. In the prior report, a 5 a.m. cutoff was used even if the actual cutoff was later or earlier because a restriction's start time is likely to have a bigger effect on crashes than the time when the restriction is lifted in the morning. Thus, for example, a night driving restriction of 1 a.m. was coded as 4 hours and a night driving restriction of 10 p.m. was coded as 7 hours. No restriction was coded as 0 hours. In some states GDL requirements are relaxed or restrictions are lifted sooner for teenagers who have completed driver's education. As with the prior HLDI report, in these states the GDL provisions applicable to those who completed driver education were coded. No distinction was made between GDL laws with primary enforcement and those with secondary enforcement.

A GDL law was assigned to a state-year if the law went into effect before October 1 of that year. Laws going into effect October 1 or later were assigned to the following year. A fourth quarter cutoff was used because laws going into effect late in the year would have little or no effect on that calendar year's results.

Analytical Methods

The primary metric used to evaluate changes in teen exposure was the ratio of teen exposure to prime age exposure. The ratio was scaled by a factor of 100 in order to improve the readability of results. A ratio was chosen because it provided a control for changes in teen exposure due to other trends or laws not included in the analysis. Ages 35-54 were selected as the control because this range provided a large stable group that was sufficiently separated from youthful and senior rated drivers.

In order to assess the effect of the recession and the economy on the teen-to-prime-age exposure ratio the difference between teen and prime age unemployment rates was used. The unemployment rate is defined as the percentage of the total labor force that is unemployed but actively seeking employment and willing to work. As population levels are already controlled for, the spread between unemployment rates provides a measure of the excess percentage of teens, compared with the prime age group, actively seeking but unable to find employment.

Linear regression was used to model the effects of GDL and the unemployment spread on the teen-to-prime-age exposure ratio. The ratio of the teen-to-prime age census population estimates was used as a control for changes in the population distribution. All regression analysis was conducted at the state level. A traditional linear model assumes that all observations have uncorrelated errors. However, due to the repeated observations for each state, one for each year, significant correlation exists. In addition, there is large variation in the teen-to-prime-age exposure ratio between states. For example in 2006, the District of Columbia had a ratio as low as 1.27, whereas Ohio had ratios as high as 5.62. There are many potential reasons for this variation including state laws not included in the analysis, availability of public transportation, population density and incomplete data. For example, teens in the densely populated District of Columbia, which has an extensive rail and bus system, may be less likely to be insured than teens living in more rural states.

In order to address the correlation and variation among states, two methods were employed. The first method includes the states as a categorical factor in the regression. The model then estimates the effect of each state on the teen-to-prime-age exposure ratio. However, this method does not directly address the correlation among observations within a state. Not properly accounting for this correlation can result in incorrect estimates and standard errors. An alternative method that addresses the correlation is to employ a linear mixed-effects model. A mixed-effects model incorporates random effects which can be thought of as unmeasured covariates. Inclusion of random effects at the state level in the model will account for the correlated observations. Under this model, state is included as a random effect and it is assumed that each state has its own state-specific mean response. The overall mean response of the teen-to-prime-age exposure ratio is then modeled as a combination of characteristics that are assumed to be shared by all states (i.e., the effects of the unemployment rate spread, GDL laws and census population ratio), and state-specific effects that are unique to that state. The former are referred to as fixed effects, while the latter are referred to as random effects. The term mixed is used to denote that the model contains both fixed and random effects. Because linear mixed-effects models explicitly distinguish between fixed and random effects, they allow the analysis of between-state and within-state sources of variation (Fitzmaurice et al., 2004).

Results

Figures 1 and 2 highlight how the metric used in this study, the teen-to-prime-age exposure ratio, has changed over time. Figures 3 - 7 illustrate how the metric has changed compared to the other factors considered in the study. Tables 1 - 3 present the results of the different regression analyses. Finally, Figure 9 illustrates the potential impact on the teen-to-prime-age exposure ratio due to changes in some of the key factors.

Figure 1 shows the national teen and prime age exposures, and the teen-to-prime-age exposure ratio (scaled by 100) from 2006 through 2012. Figure 2 shows the national teen and prime age exposures indexed to 2006. Prime exposure was much higher than teen exposure, averaging 24,825,082 insured vehicle years over the period, compared with 986,725 insured vehicle years for teenagers. In 2008, prime exposure peaked reaching 25,674,949 insured vehicle years, a 5 percent increase over 2006 values. Teen exposure peaked in 2007, reaching 1,045,510 insured vehicle years, or 3 percent higher than 2006 values. By 2012, prime exposure had fallen to 96 percent of its 2006 level whereas teen exposure had decreased to 88 percent. The teen-to-prime-age exposure ratio shows that from 2006 to 2010, the exposure of teens compared with prime age drivers decreased, from 4.2 to 3.8. However, between 2010 and 2012 the ratio remained relatively constant.

Figure 1: Comparison of national teen and prime-age exposures

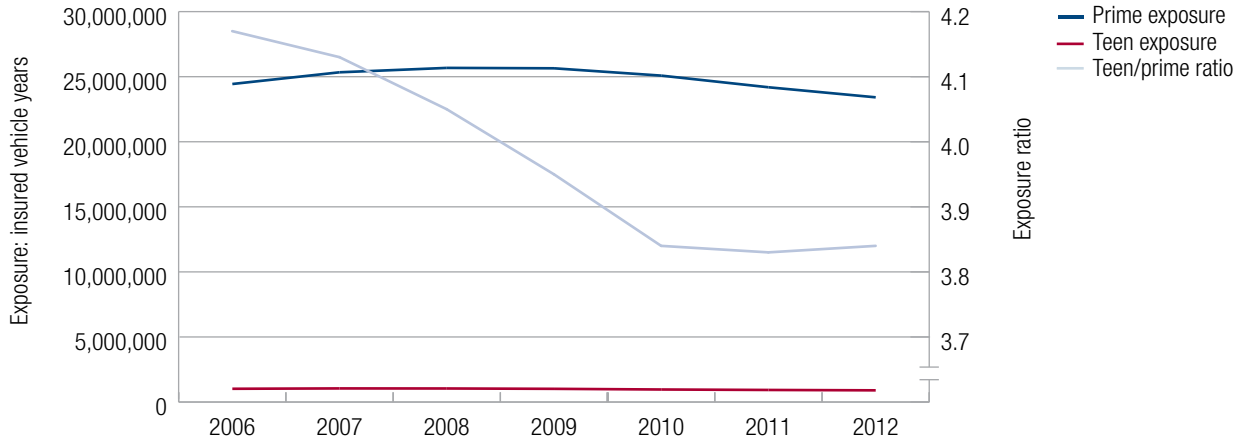
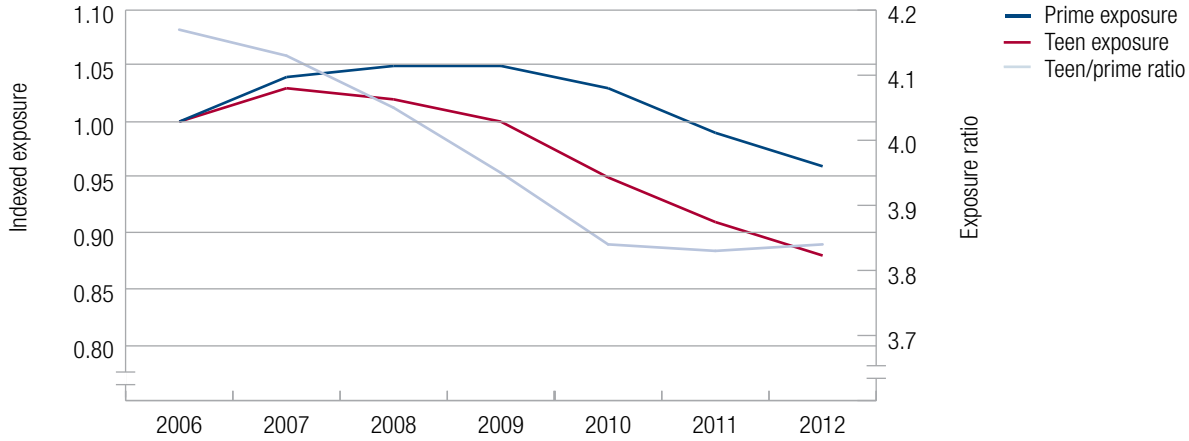


Figure 2: Comparison of national teen and prime-age exposures indexed to 2006



The purpose of Figures 3 and 4 is to illustrate the extent to which the metric used in this study responds to known changes in GDL laws. Figure 3 shows the effect of the intermediate licensing age on the exposure ratio for teens 16 and under. Only teens 16 and under were included in this figure because those are the ages directly impacted by this GDL law. Although the inherent variation among states is not controlled for in these figures, it is clear that the intermediate licensing age does affect teen exposure in a state and that the effects are observable in the HLDI database. As one would expect, New Jersey, which had the highest intermediate licensing age of 17, has virtually no exposure for ages under 17 . South Dakota, which has the lowest intermediate licensing age of all states at 14 and 3 months (with driver's education), has an exposure ratio of roughly twice that of Arkansas, which has an intermediate licensing age of 16.

Figure 3: Ratio of 16-and-under exposure to prime-age exposure in three states with different licensing ages

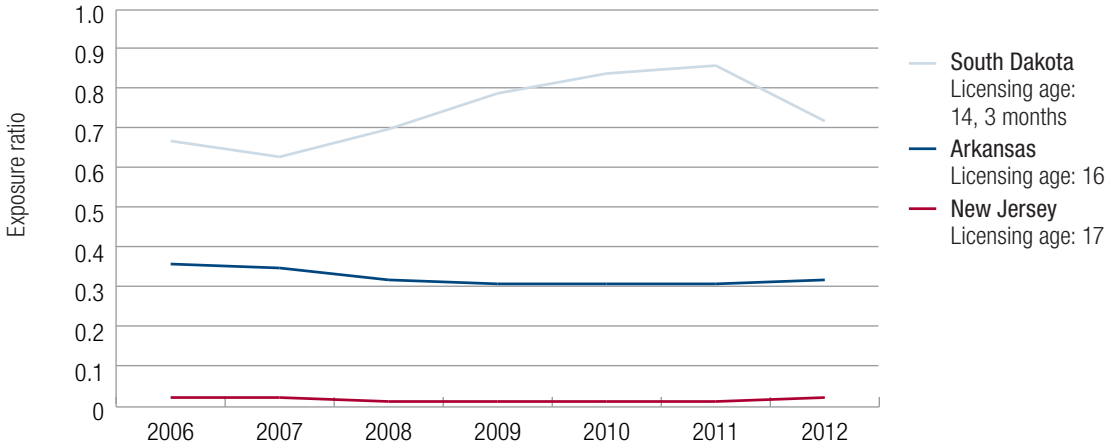


Figure 4 illustrates that changes to the intermediate licensing age are also observable with the HLDI database. Between 2006 and 2012, three states increased their intermediate licensing age: Indiana from 16 years, 1 month to 16 years, 6 months (with driver's education) on July 1, 2010; Mississippi from 15 years, 6 months to 16 years on July 1, 2009; and Maryland from 16 years, 3 months to 16 years, 6 months on October 1, 2009. Following implementation of these laws, all three states exhibited decreases in the ratio of 16-and-under exposure to prime-age exposure.

Figure 4: Ratio of 16-and-under exposure to prime-age exposure in three states where the licensing age changed

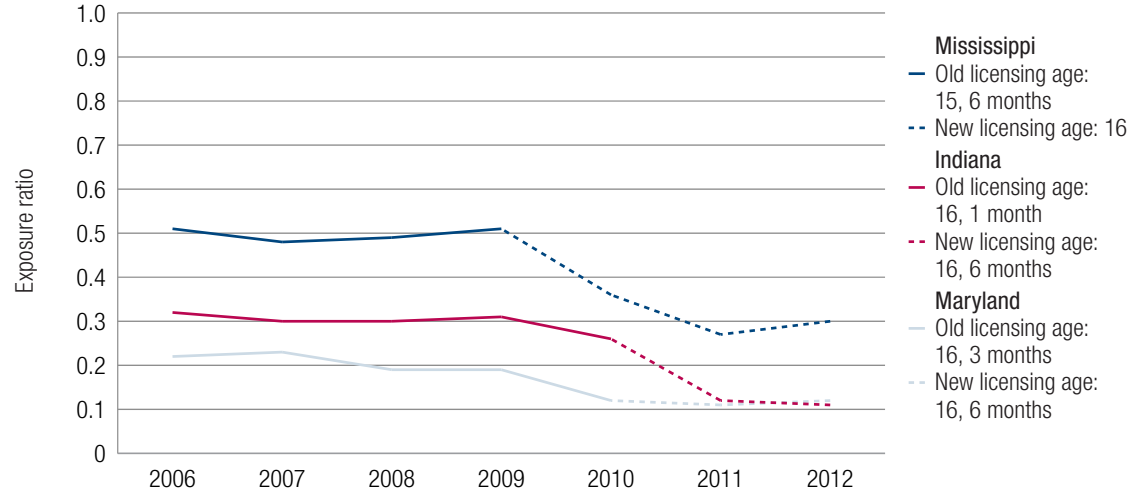


Figure 5 compares the national teen-to-prime-age exposure ratio with the teen-to-prime-age census population ratio. Both ratios have been scaled by 100 to improve readability. The national census population ratio remained fairly constant, decreasing from 30.2 to 30.1 between 2006 and 2012. Compared with the exposure ratio, the census population ratio was over 7 times larger. This indicates that relative to the prime age group, the level of teens in the overall population is much higher than that of insured teens.

Figure 5: National teen-to-prime-age exposure and census population ratios

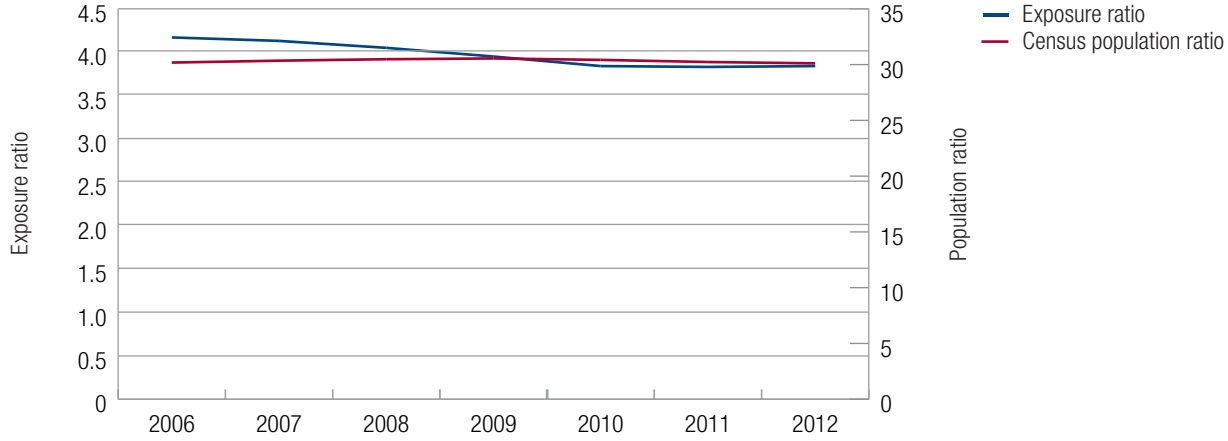


Figure 6 shows the national unemployment rates for the teen and prime age groups, as well as the spread between them. The teen unemployment rate is much higher than the prime age unemployment rate, reaching a maximum difference in the unemployment spread of 18 percent in 2010. In addition, while both age groups experienced increased unemployment between 2006 and 2010, teen unemployment rose more, as indicated by the unemployment spread. From 2006 to 2010 the teen unemployment rate rose from 15 percent to 26 percent, an increase of 11 percentage points, while the prime age unemployment rate increased from 3 percent to 8 percent, an increase of 5 percentage points.

Figure 6: National teen vs. prime unemployment rates

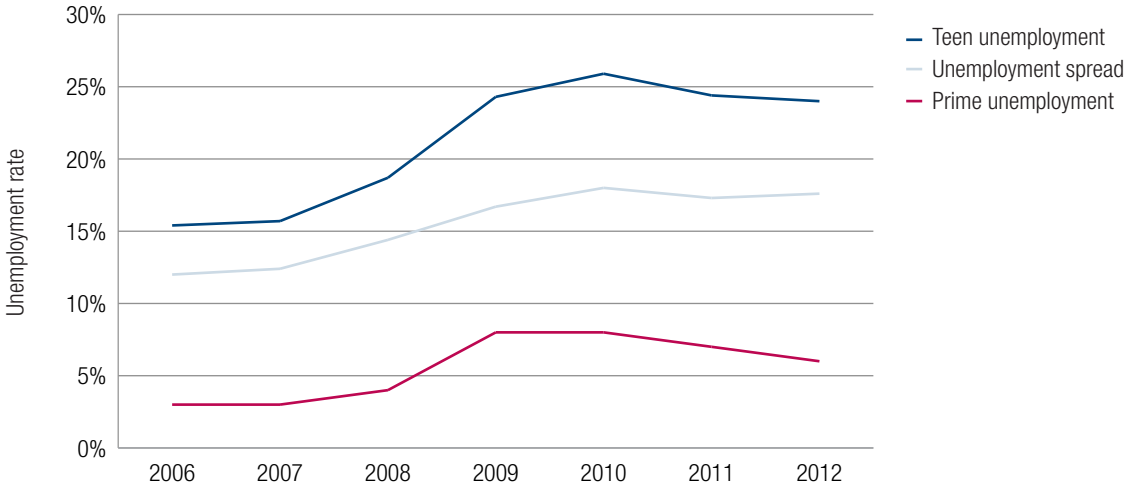


Figure 7 highlights the inverted relationship between the national teen-to-prime-age exposure ratio and the national unemployment spread. Note that the vertical axes on this figure have been truncated. From 2006 to 2010, as the unemployment spread increases, a higher percentage of teens compared with prime age are unable to find employment. At the same time fewer teenage drivers are being insured relative to prime age drivers, and the teen-to-prime-age exposure ratio decreases. From 2010 to 2012, the unemployment spread remains relatively constant, and the teen-to-prime-age exposure ratio remains constant as well.

Figure 7: National teen-to-prime-age exposure ratio and unemployment spread

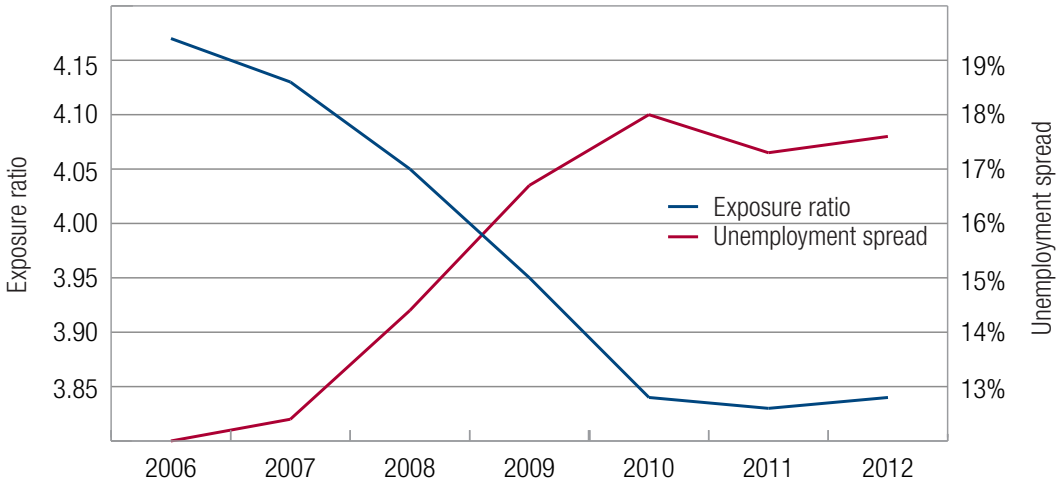


Figure 8 shows the national distribution of insured teen drivers between 2006 and 2012. During this time the distribution shifted slightly towards older teenagers, with the proportion of insured drivers age 17 and younger decreasing from 29 percent of the insured teen population to 28 percent and insured 18 and 19-year-old drivers increasing from 71 percent to 72 percent.

Figure 8: National age distribution of teen drivers 2006 to 2012

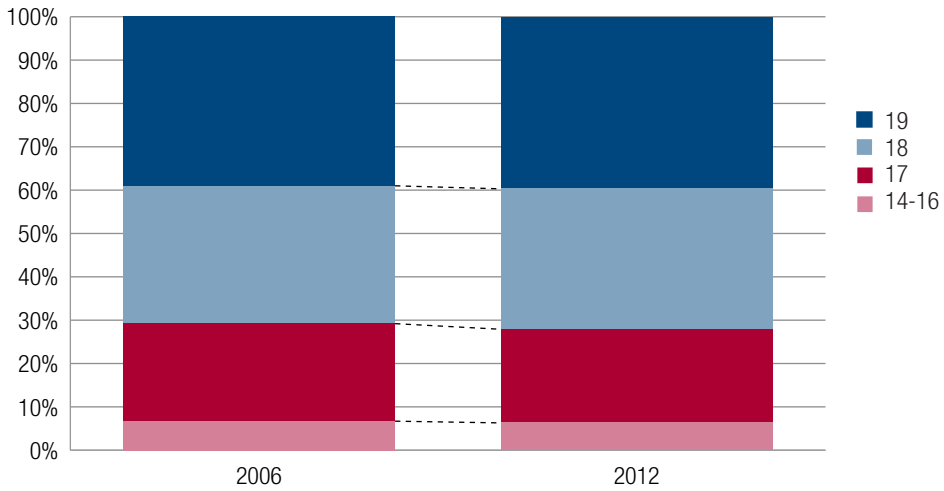


Table 1 summarizes the results of the linear regression model using only fixed effects and treating state as a categorical factor. Under this model, the unemployment spread and intermediate licensing ages are the two parameters significant at the 95 percent confidence level with estimates of -0.017 and -0.935 respectively. The model estimates that a 1 point increase in the unemployment spread (i.e. from 10 percent to 11 percent) will on average result in a 0.017 decrease in the mean teen-to-prime-age exposure ratio. At the state level, the unemployment spread increased as much as 13.3 points between 2006 and 2012. According to the model, this would result in a decrease to the mean teen-to-prime-age exposure ratio in that state of 0.23. Similarly, the model estimates that for a one-year increase in a state's intermediate licensing age the mean teen-to-prime-age exposure ratio will on average decrease by 0.935. Given the results of Figures 3 and 4, this estimate seems high and could be a result of not properly accounting for the correlation between observations within a state. The census population ratio and passenger restrictions were significant at the 90 percent confidence level. The effect of the census population ratio was positive; as the overall teen population increases relative to the prime age population, the number of insured teen drivers relative to prime age drivers increases as well. The effect of the passenger restriction was negative. Further analysis of the data showed that those states without passenger restrictions were typically also those states that had a higher base teen-to-prime-age exposure ratio. The significance of this result may be more an artifact of confounding with the states than an indication that passenger restrictions result in decreased teen exposure. The learner's permit age, holding period and supervised driving all had positive effects, but none were statistically significant. Permit holders do not show up in the HLDI database as they are not insured so this result is not unexpected.

Table 1: Summary of fixed model regression results

Parameter	Estimate	Standard error	P-value
Intercept	9.3636	9.2665	0.3131
Unemployment spread	-0.0171	0.0037	<0.0001
Census population ratio	0.0733	0.0438	0.0953
Intermediate age	-0.9352	0.3512	0.0082
Learner's permit age	0.4196	0.5251	0.4250
Holding period	0.0275	0.0208	0.1871
Supervised driving	0.0008	0.0019	0.6638
Nighttime restriction	-0.0127	0.0185	0.4955
Passenger restriction	-0.1432	0.0744	0.0554
No passenger restriction	0	—	—

Table 2 summarizes the results of the mixed model regression where state is treated as a random effect. The results are fairly similar to Table 1 with the main exception being that the estimate for the intermediate licensing age in now -0.421 with a p-value of 0.0905. A six-month increase in the intermediate licensing age is associated with a 0.21 decrease in the mean teen-to-prime-age exposure ratio for a typical state. This result appears consistent with Figures 3 and 4. Table 3 lists the results of a reduced model where only the unemployment spread, intermediate licensing age and census population ratio are included beyond the random state effects.

Table 2: Summary of mixed model regression results, full model

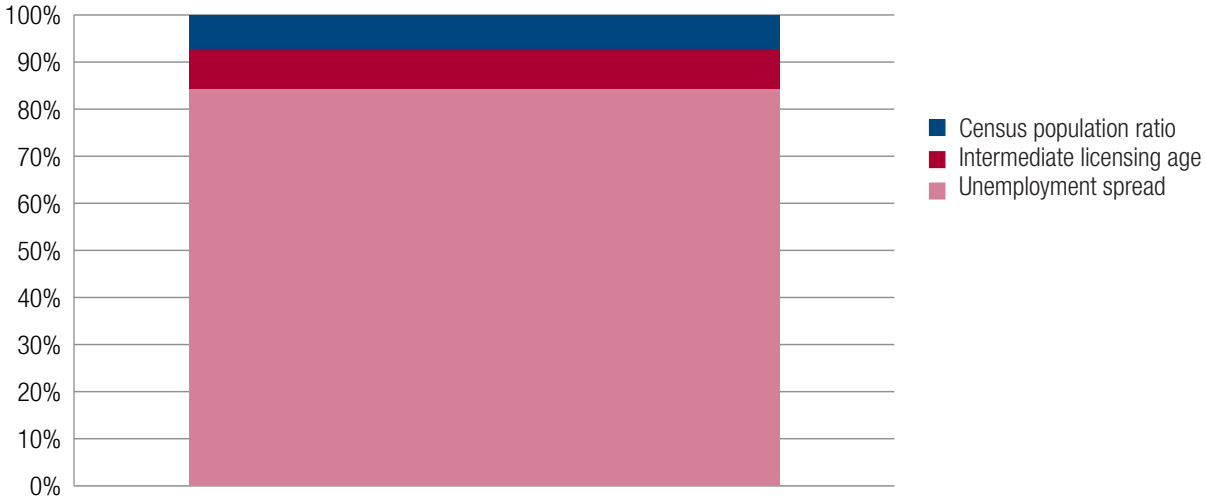
Parameter	Estimate	Standard error	P-value
Intercept	6.0577	3.9995	0.1363
Unemployment spread	-0.0179	0.0037	<0.0001
Census population ratio	0.0633	0.0339	0.0633
Intermediate age	-0.4210	0.2479	0.0905
Learner's permit age	0.2053	0.2303	0.3736
Holding period	0.0076	0.0173	0.6627
Supervised driving	-0.0006	0.0018	0.7543
Nighttime restriction	-0.0136	0.0175	0.4385
Passenger restriction	-0.1140	0.0699	0.1040
No Passenger restriction	0	—	—

Table 3: Summary of mixed model regression results, reduced model

Parameter	Estimate	Standard error	P-value
Intercept	7.9707	3.1542	0.0148
Unemployment spread	-0.0195	0.0036	<0.0001
Census population ratio	0.0543	0.0331	0.1025
Intermediate age	-0.3358	0.1763	0.0577

Figure 9 provides estimates for how much each factor from Table 3 contributed to the decline in the teen-to prime-age exposure ratio predicted by the reduced mixed-effects model. For each factor the change in the teen-to-prime-age exposure ratio from 2006 to 2012 was predicted while holding all other factors constant at their 2006 levels. The overall changes predicted for each factor were then combined. Using this method, almost 85 percent of the decline predicted by the model was associated with changes in the unemployment spread. Approximately 8 percent and 7 percent of the decline was associated with changes to the intermediate licensing age and census population ratios respectively. Based on the conditional R^2 (Nakagawa and Schielzeth, 2013), the model accounts for 93 percent of the variance in the teen-to-prime-age exposure ratio. Thus approximately 79 percent (85 percent times 93 percent) of the overall decline in the teen-to-prime-age exposure ratio is estimated to be associated with changes in the unemployment spread.

Figure 9: Model estimated percent contribution to decline in teen-to-prime-age exposure ratio between 2006 to 2012



Discussion

Some studies have shown that fewer teenagers have been getting their licenses with many media reports speculating that the economy is the driving force behind this. This study confirms that between 2006 and 2012 the level of insured teens, as measured by the teen-to-prime-age exposure ratio, has declined as well. Coinciding with this decline, unemployment and the costs of owning and driving a car have increased. Under these circumstances a person faced with poor employment prospects and rising costs may choose not to drive and insure their vehicle. Teens were hit particularly hard by the recession with unemployment rates exceeding that of the prime age group by 18 percentage points nationally in 2010. Consequently, it stands to reason that a higher percentage of teens would be unable to afford insurance resulting in a lower teen-to-prime-age exposure ratio. Results of the regression analysis were consistent with this hypothesis, showing that the unemployment spread was a significant predictor of the teen-to-prime-age exposure ratio. The reduced mixed-effects regression model estimated that the unemployment spread was associated with as much as 85 percent of the decline in the teen-to-prime-age exposure ratio from 2006 to 2012.

Teens may also have been doubly affected by the recession and high unemployment. Increased unemployment across all age groups means that not only are teens struggling to afford the costs associated with driving, but their parents may be less willing or even able to help subsidize those costs. If parents are unable to afford an extra car for their teen to use, the teen may have less incentive to obtain their license.

Although this study was not a comprehensive review of GDL laws, their effects on the level of insured teens over the 2006 to 2012 time period were also examined. However, by 2006 most states already had GDL laws in place. While it is possible that changes to these laws were responsible for reductions in the level of insured teens prior to 2006, they did not significantly contribute to the decline between 2006 and 2012. Regression results confirm this with only the intermediate licensing age being marginally significant. The intermediate licensing age has a direct impact on the level of insured teens as only teens at or above that age are able to be licensed and obtain insurance. However, only a few states increased the intermediate licensing age during the 2006 to 2012 time period. While the impact on the teen-to-prime-age exposure ratio for these states was observable in the data, it is not enough to account for the overall decline at the national level or in other states.

Similarly, **Figure 8** shows that while there was a slight shift towards older teens, the distribution of insured teen drivers remained relatively constant between 2006 and 2012. This suggests that any change in the insured teen distribution as a result of delaying licensure in order to avoid GDL restrictions would have occurred prior to 2006.

Ultimately, the results of this study indicate that the recession was the most significant factor in the decline to the levels of insured teens between 2006 and 2012. While GDL laws were shown to have the potential for a large impact, most of these laws were enacted prior to 2006. Any changes to the level or distribution of insured teens due to GDL laws would most likely have occurred before the time period for this study.

References:

AAA. 2006. Your driving costs: How much are you really paying to drive? Heathrow, FL: AAA.

AAA. 2012. Your driving costs: How much are you really paying to drive? Heathrow, FL: AAA.

Bachman, J. G., Johnston, L. D., O'Malley, P. M., and Schulenberg, J. E. 2006. The Monitoring the Future project after thirty-two years: Design and procedures (Occasional Paper No. 64). Ann Arbor: Institute for Social Research, The University of Michigan.

Bachman, J. G., Johnston, L. D., & O'Malley, P. M. 2011. Monitoring the Future: Questionnaire responses from the nation's high school seniors, 2010. Available from: http://monitoringthefuture.org/datavolumes/2010/2010dv.pdf

Burden, M.; Henkel, K.; and Shepardson, D. 2013. GM economist debunks talk that the younger set doesn't like cars. The Detroit News, August 6.

Davis, B.; Dutzik, T.; and Baxandall, P. 2012. Transportation and the new generation: Why young people are driving less and what it means for transportation policy. Santa Barbara, CA: Frontier Group.

Fan, X., Miller, B. C., Park, K., Winward, B. W., Christensen, M., Grotevant, H. D., et al. 2006. An exploratory study about inaccuracy and invalidity in adolescent self-report surveys. Field Methods,18, 223–244.

Fitzmaurice, G.M, Laird, N.M. and Ware, J.H. 2004. Applied longitudinal analysis. Wiley-Interscience, Hoboken, NJ.

Foss, R.D. 2013. Did graduated driver licensing increase the number of newly licensed 18-year-old drivers in North Carolina? Presentation at Transportation Research Board Annual Meeting, Washington, D.C., January 15, 2013. Available: http://www.youngdriversafety.org/presentations.

Gorzelany, J. 2012. Social media trumps driving among today's teens. Forbes, January 23.

Halsey III, A. 2013. Teens in no hurry to land a driver's license, AAA finds. The Washington Post, August 1.

Highway Loss Data Institute. 2009. Graduated driver licensing laws and insurance collision claim frequencies of teenage drivers. Insurance special report A-79. Arlington, VA.

Insurance Institute for Highway Safety. 2006. Quality, timeliness, and comprehensiveness of motor vehicle registration and licensed driver information; comment to Federal Highway Administration on 23 CFR 420, Planning and research program administration, Docket no. FHWA-2005-22706. Arlington, VA.

Nakagawa, S., and H. Schielzeth. 2013. A general and simple method for obtaining R^2 from generalized linear mixed-effects models. Methods in Ecology and Evolution 4(2): 133-142.

Scholettle, B. and Sivak, M. 2013. The reasons for the recent decline in young driver licensing in the U.S. Report no. UMTRI-2013-22. Ann Arbor, MI: University of Michigan Transportation Research Institute.

Shults, R.A., and Williams, A.F. 2013. Trends in driver licensing status and driving among high school seniors in the United States, 1996-2010. Journal of Safety Research 46: 167-170.

Sivak, M. and Schoettle, B. 2011. Recent changes in the age composition of U.S.drivers: Implications for the extent, safety, and environmental consequences of personal transportation. Traffic Injury Prevention 12:588-92.

Sivak, M. and Schoettle, B. 2012a. Update: Percentage of young persons with a driver's license continues to drop. Traffic Injury Prevention 13:341.

Sivak, M. and Schoettle, B. 2012b. Recent changes in the age composition of drivers in 15 countries. Traffic Injury Prevention 13:126-32.

Tefft, B. C.; Williams, A.F., and Grabowski, J.G. 2013. Timing of driver's license acquisition and reasons for delay among young people in the United States. AAA Foundation for Traffic Safety.

U.S. Bureau of Labor Statistics.

U.S. Census Bureau.

Williams, A.F. 2011. Teenagers' licensing decisions and their views of licensing policies: a national survey. Traffic Injury Prevention 12: 312-19.

HIGHWAY LOSS DATA INSTITUTE

1005 N. Glebe Road, Suite 700
Arlington, VA 22201 USA
tel 703/247-1600
fax 703/247-1595
iihs-hldi.org