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Cigarette Prices and Driving Fatalities Among Youths

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Abstract

Deaths from motor vehicle crashes are a leading cause of unintentional deaths in the United States. This paper investigates the effect of increases in cigarette taxes and prices following the Master Settlement Agreement (MSA) on non-alcohol and alcohol-related motor vehicle fatalities among youths. I find that increases in cigarette taxes and prices are associated with a reduction in non-alcohol related accidents between 1998 and 2006 among 16-to-20 year olds.

JEL codes: I10, I12, I18
Keywords: Cigarette Taxes and Prices, Driving Fatalities, Externalities

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1 Introduction

The U.S. Department of Transportation's National Highway Traffic Safety Administration estimates the economic costs of motor vehicle crashes of $900 for each person living in the U.S. in 2010. Several policy measures that can reduce driving fatalities have been recognized including increases in alcohol taxes (Saffer and Grossman, 1987; Young and Bielinska-Kwapisz, 2006; Ruhm, 1996), texting bans (Abouk and Adams, 2013; Carpenter and Nguyen, 2015), and increases in minimum wage (Adams, Blackburn and Cotti (2012)).

A strand of literature that focuses on the effects of smoking on public health outcomes finds that smoking reduction, particularly due to increases in cigarette prices and taxes, lead to an increased life expectancy and improved birth and infant health outcomes (Evans and Ringel, 1999; Markowitz, 2008; Markowitz et al., 2013; Simon, 2016). Similarly, several studies consistently suggest smoking as a risk factor contributing to motor vehicle collision (Brison, 1990; Christie, 1991; Violanti and Marshall, 1996; Stutts et al., 2001; Mangiaracina and Palumbo, 2006; Young, Regan and Hammer, 2007; Prat et al., 2015; Lansdown, Stephens and Walker, 2015; Sullman, Prat and Tasci, 2015).[1] In a literature review, Christie (1991) reveals that smokers have increased crash risk compared to non-smokers even after accounting for observed characteristics such as age, gender, education, alcohol consumption and driving experience. In a more recent study, Pederson et al. (2019) find that smoking restriction in vehicles in Ontario (January, 2009) abridged the gap in motor vehicle collusion between smokers and non-smokers following the legislation compared to the period before. However, such findings are still likely to be driven by unobserved differences between smokers and non-smokers – omitted variables such as low discount rate and risk seeking behavior present among smokers are likely to confound the findings.

This is the first study to evaluate the effect of cigarette price and tax increases following MSA on non-alcohol and alcohol-related fatal accidents among 16-to-20 year olds.[2] MSA is the largest litigation settlement in the U.S. history that took place in November 1998 between the attorney generals of 46 states and the four major tobacco companies (Brown and Williams, Lorillard Tobacco Company, Phillip Morris, and R. J. Reynolds). This resulted in cigarette companies paying the states $206 billion over the span of 25 years. Following the settlement, the cigarette prices increased dramatically, along with increases in excise taxes due to the ongoing publicity from MSA (Cutler et al., 2002; Sloan and Trogdon, 2004; Shrestha, 2016). Figure 1 shows across state variation in changes in cigarette taxes between 1998 and 2006 (in 2013 dollars).

The findings of this study reveal that increases in cigarette prices and taxes following MSA are associated with a reduction in non-alcohol fatalities among youths. The result can be explained by the negative relationship between cigarette taxes and youth's smoking (Sloan and Trogdon, 2004; Marshall et al., 2006; Markowitz and Tauras, 2006; Carpenter and Cook, 2008).

2 Cigarettes and Driving Fatalities

To provide a conceptual understanding, I present the following structural equations:

$$Driving\ Accident = G(Risky\ Driving,\ Frequency\ Driving,\ X_1,\ Z_1) \tag{1}$$

[1] California, Louisiana, Maine, Oregon, Utah, Vermont, and Virginia have smokefree car laws contingent upon age of a person in the vechicle. http://www.no-smoke.org/learnmore.php?id=616

[2] Although youths (15-to-20) represent 6.4 percent of all drivers, they all account for 10 percent of motor vehicle traffic deaths ((Klauer et al., 2014)). Also, they face tighter budget constraint compared to adults.

$$Risky\ Driving = F(Drunk\ Driving,\ Distracted\ Driving,\ X_2) \tag{2}$$

$$Frequency\ Driving = E(Disposable\ Income,\ Gas\ Prices,\ X_3) \tag{3}$$

where, driving accident is a function of risky driving, frequency of driving, personal characteristics X (e.g. age, drivers training, experience), and location specific characteristics Z_1 (e.g. road condition, weather, time of day, congestion) as shown in equation (1). Increases in cigarette prices and taxes following MSA can affect equation (1) by altering youth's driving behaviors through equations (2) and (3). Equation (2) presents risky driving as a function of drunk driving, distracted driving, and an individual's risk preference X_2. In fact, drivers' inattention is one of the major determinants of traffic accidents, with 20 to 50 percent of crashes related to some form of inattention (Administration, 1997; Ranney et al., 2000). Increases in cigarette prices and taxes increases the likelihood of drunk driving if young adults substitute cigarettes for alcohol and vice-versa if cigarettes and alcohol are complements.

Distracted driving is a result of engagement in other activities while driving, including cell phone usage, eating and drinking in car, using entertainment system, and smoking (Young, Regan and Hammer, 2007). Since 2007, several states have implemented laws prohibiting text messaging.[3] However, relatively little attention has been given when discussing weather smoking causes distracted driving, although smokers typically tend to smoke in their vehicle and have significantly higher collusion rate compared to non-smokers.[4]

Several moments in the process of smoking can result in an increased risk of accident, such as lighting the cigarette, reaching or looking for a cigarette, cigarette smoke blowing back into the vehicle, and dropping the cigarette (Young, Regan and Hammer (2007)). Using evidence from video recordings, Mangiaracina and Palumbo (2006) find that an average driving distraction imposed by smoking is 12 seconds. This translates to a distance of 160 meters at a speed of 50 km/h. The process of multi-tasking while driving can be detrimental among novice youths compared to experienced drivers (Durbin et al., 2014). The relatively recent studies (McEvoy, Stevenson and Woodward, 2006; Prat et al., 2015; Sullman, Prat and Tasci, 2015) provide direct survey evidence of smoking as one of the major causes of distraction while driving. A reduction in prevalence of smoking due to increases in cigarettes prices and taxes in venues including motor vehicles can reduce instances of distracted driving.[5]

In equation (3), increases in cigarette prices and taxes can affect a smoker's disposable income. Although several studies conclude that the demand for cigarette is elastic among youth (Lewit, Coate and Grossman (1981); Grossman et al. (1983); Chaloupka and Grossman (1996); Chaloupka and Wechsler (1995), these studies rely on the time frame before MSA. Studies using variation in cigarette taxes after MSA, mirroring the time frame of this study, provide a consensus that youth's demand for cigarette is inelastic ((Sloan and Trogdon, 2004; Markowitz and Tauras, 2006; Carpenter and Cook, 2008; DeCicca et al., 2008)). In this case, higher cigarette prices will lower the net disposable income, leaving teenagers with less money for gas. This

[3] Abouk and Adams (2013) find that texting ban enforced as a primary offense reduce accidents for a brief period.

[4] A study from the Minnesota Department of Health concluded that the most common setting for Environmental Tobacco Smoke (ETS) exposure among youths were public place (31 percent) and motor vehicle (20 percent) in 2014 (see https://apps.health.state.mn.us/mndata/ets_youth). Marshall et al. (2006)'s results indicate that 80 percent of youth current smokers rode in car with someone smoking a cigarette in the past 7 days. Even among older adults, Nabi-Burza et al. (2012) find that approximately 70 percent of smoking parents had no smoke-free car policy.

[5] Data from the Minnesota Department of Health suggests that youths' exposure to ETS in cars have declined between 2000 and 2014.

channel further reduces risk of driving accidents.

Additionally, states can use increases in tax revenue from higher cigarette taxes to fund highway expenditures.[6] Improvements in road conditions can directly affect risk of driving accident in equation (1) through Z_1. Better road conditions are more likely to benefit teenage drivers, generally with less experience.

3 Data and Empirical Method

3.1 Data

The primary data used in this study comes from the Fatality Analysis Systems (FARS) of NHTSA (1998 to 2006). I follow the procedure used by NHTSA to generate their official statistics and calculate the number of non-alcohol-related and alcohol-related crashes that involves a 16-to-20 year old driver for each state and year cell. The non-alcohol-related crashes are defined as accidents with the blood alcohol concentration level (BAC) of a driver equivalent to zero and alcohol-related driving fatalities comprise of accidents with BAC level of greater than zero.[7]

Data for cigarette prices and taxes come from the Tax Burden on Tobacco (Council (2014)). As a form of relevant smoke free air (SFA) law, I include the states with 100 percent smoking ban in bars. Information regarding the smoking ban in bars is extracted from the Americans for Non-Smokers' Rights database.To account for population growth, I include the log of population pertaining to 16-to-20 year olds, which is obtained from the National Cancer Institute's Seer population database (National Cancer Institute, 2016).

Beer taxes (per gallon), convereted to 2013 dollars, are used to capture the monetary cost of alcohol, and beer taxes are extracted from the Brewers Almanac (2013). Other alcohol control policies accounted for include the vertical ID law, Sunday sales ban, and state's adaption of BAC level of 0.08 percent. Information regarding alcohol control policies comes from the Alcohol Policy Information System database.

Additionally, I include the real state-level gasoline taxes (per gallon) from the Office of Highway Policy Information. To account for the trend in youth driving and revenue collected from motor fuel taxation, I use the log number of youths with driving licenses and volume of motor fuel subjected to state taxation, respectively (Office of Highway Policy Information). Also, I control for the state unemployment rates and log of per capita income. The implementation of state-level primary seatbelt laws comes from the Centers for Disease Control and Prevention (CDC).

3.2 Empirical Model

First, the effect of increases in cigarette prices on driving fatalities is identified by using within state variation in cigarette prices over time, particularly following MSA. The estimation strategy is based on the following specification:

$$log(D_{st}) = \alpha + \beta(CigTaxes_{st}) + \lambda(BeerTax_{st}) + \gamma AlcPolicy_{st} + \mu Z_{st} + \rho_s + \tau_t + e_{st} \qquad (4)$$

where, $log(D_{st})$ is a measure of log of driving fatalities specific to state s in year t, $CigTaxes_{st}$ and $BeerTax_{st}$ include real cigarette taxes (per pack) and real beer taxes (per gallon) converted to 2013 dollars (expressed per 10 cents), and $AlcPolicy_{st}$ consists of alcohol control policies. Z is a vector of state specific controls. The

[6] http://idahocfp.org/new/wp-content/uploads/2016/12/Tobacco-Cigarette-Taxes-2016-PRINT-Gray.pdf
http://www.kpcnews.com/opinions/our_view/kpcnews/article_efe23216-d176-543a-bab7-7884f436f361.html

[7] This definition is used by Adams, Blackburn and Cotti (2012).

above specification includes state fixed effects (ρ_s), year fixed effects (τ_t) and state specific linear time trends. I separate my analysis into two groups: 1) 16-20 year olds; and 3) 26-30 year olds.[8] The standard errors are clustered at the state level. The analysis conducted involves two outcome variables (alcohol and non-alcohol related fatalities) and two age groups, leading to four set of regressions. I present the p-values obtained from the stepdown method as described in Romano and Wolf (2005*a*) and Romano and Wolf (2005*b*) to account for testing all four set of hypotheses (four coefficients on cigarette taxes) in order to correct for Family Wise Error Rate from the multiple hypotheses.

Two previous findings allow me to hypothesize that the effects of cigarette prices and taxes on driving fatalities will be pronounced among youths compared to older adults: 1) The price elasticity of cigarettes is higher among youths for the period after MSA ((Sloan and Trogdon, 2004; Carpenter and Cook, 2008)); and 2) Cigarettes make up a larger proportion of youth smoker's disposable income.

Next, I run the following event study model using changes in cigarette taxes within states over the years following MSA:

$$log(D_{st}) = \alpha \ + \beta_j(\sum_{j=-3}^{1} num_j{*}Cig\,Tax\,Difference_s) + \beta_j(\sum_{j=1}^{5} num_j{*}Cig\,Tax\,Difference_s) \tag{5}$$

$$+ \lambda(Beer\,Tax_{st}) + \gamma Alc\,Policy_{st} + \mu Z_{st} + \rho_s + \tau_t + e_{st} \tag{6}$$

where, num is an indicator variable taking the value 1 if the number of years away from the year prior to the tax change year (between 1998 and 2006) is equal to j; otherwise the value it take is 0. Indicator num is interacted with $Cig\,Tax\,Difference_s$, which amounts to the real difference in cigarette taxes between 1998 and 2006 in state s evaluated in 2013 dollars. The omitted category is the year prior to the tax change. Note that state-level cigarette taxes were quite stable between 1998-2002 and only started to increase from 2002 onwards (see Figure 2). This allows us to conduct an event study to access the trend in driving fatalities in years prior to the tax change and years following the tax change. The other variables specified are similar to equation 4. The coefficients on β_j evaluate the effect of tax change on driving fatalities compared to one year prior to the change (omitted year). Coefficients on β_j ($j < 0$) provides suggestive evidence regarding the pre-existing trends in traffic fatalities.

4 Results

4.1 Descriptive Statistics

Figure 2 shows the trend in non-alcohol related driving fatalities among 16 to 20 year old youths and real cigarette taxes from 1998 to 2006. State-level cigarette taxes per a pack averaged approximately 50 cents in 1998 but the average taxes amounted over $1 in 2006. Figure 2 shows that the timing of increases in cigarette taxes mirror the fall in non-alcohol related driving fatalities among 16-to-20 year olds.

4.2 Main Results

Table 2 presents the findings of the study, where the standard errors are reported in parenthesis and Romano-Wolf p-values testing for four hypotheses are presented in square brackets (coefficients on cigarette taxes). The findings shown in Column (1) suggests that a 10 cent increase in cigarette taxes are associated with a reduction in non-alcohol-related fatal accidents by 1.3 percent among 16-to-20 year olds and the coefficient is

[8] The findings for relatively older individuals remain similar to the findings for 26-30 year olds.

significant at a 1 percent level. The Romano-Wolf p-value is of 0.03. Although the coefficient on cigarette taxes in Column (3), pertaining to non-alcohol-related fatalities for 26-to-30 year olds, is negative, the coefficient is statistically insignificant at the conventional levels (Romamo Wolf p-value of 0.8606). In contrast, increases in cigarette taxes have no effect on alcohol-related driving fatalities among individuals of both age groups.

Figure 2 shows the findings from an event study model that uses changes in cigarette taxes following MSA. The figure plots the coefficients of β_j after estimating equation 5 for non-alcohol and alcohol-related driving fatalities across both age groups. The omitted year is the year before the tax change went into effect. Panel (a) in Figure 2 shows a trend-break in non-alcohol-related driving fatalities among 16-to-20 year olds in the year when tax change when into effect. Specifically, a 10 cent increases in cigarette taxes per a pack reduces non-alcohol related fatalities in the year of tax change by 0.6 percent and the coefficient is significant at the 5 percent level. The effects of cigarette taxes remain persistent over the years following the year of tax change for non-alcohol related fatalties among 16-to-20 year olds. When focusing on alcohol related fatalities among this age group, the coefficients are noisy and fluctuate around zero.

Panel (b) in Figure 2 indicates that increases in cigarette taxes between 1998 and 2006 had no effect on both non-alcohol and alcohol related fatalties among relatively older individuals. The coefficients on β_j are nosiy and fluctuates around zero. As a robustness exercise, we further replicate the main findings using cigarette prices instead of taxes. The results, presented in Table 4, are similar to the main findings.

5 Conclusion

This is the first study to show that cigarette taxes and prices following the MSA are negatively associated with non-alcohol-related driving fatalities among youths. The results are robust to alternate model specifications that include cigarette prices instead of taxes. It is important to understand the mechanisms driving the findings of this study before tying in policy implications with the findings. Particularly, is the reduction in non-alcohol related accidents among youths driven by less episodes of distracted driving, due to re-allocation of youth's budget constraint, or allocation of tax revenue towards highway maintainance?

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6 Figures and Tables

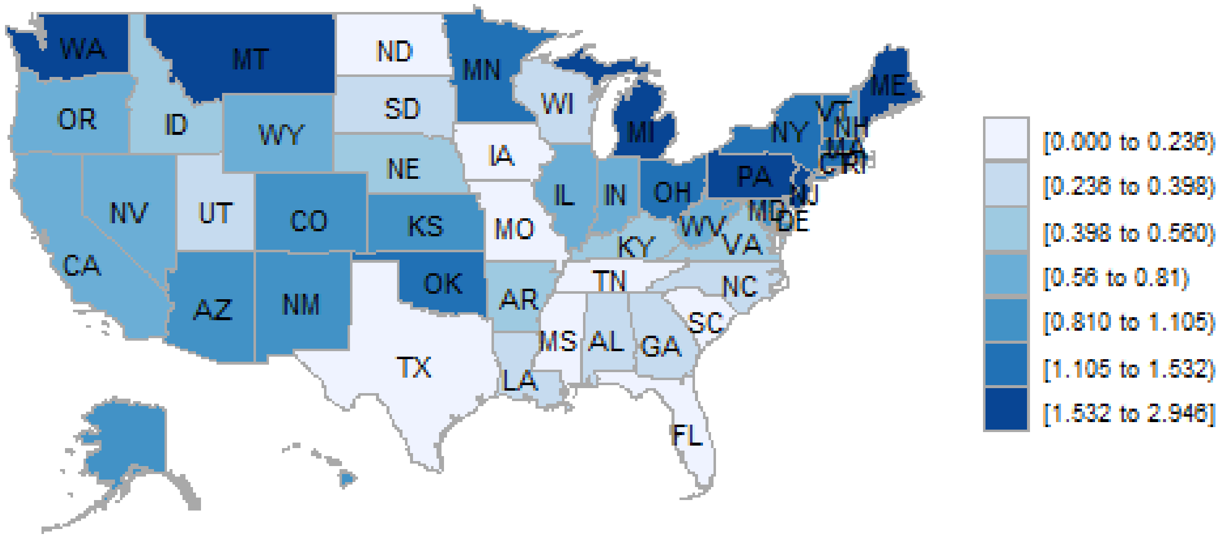
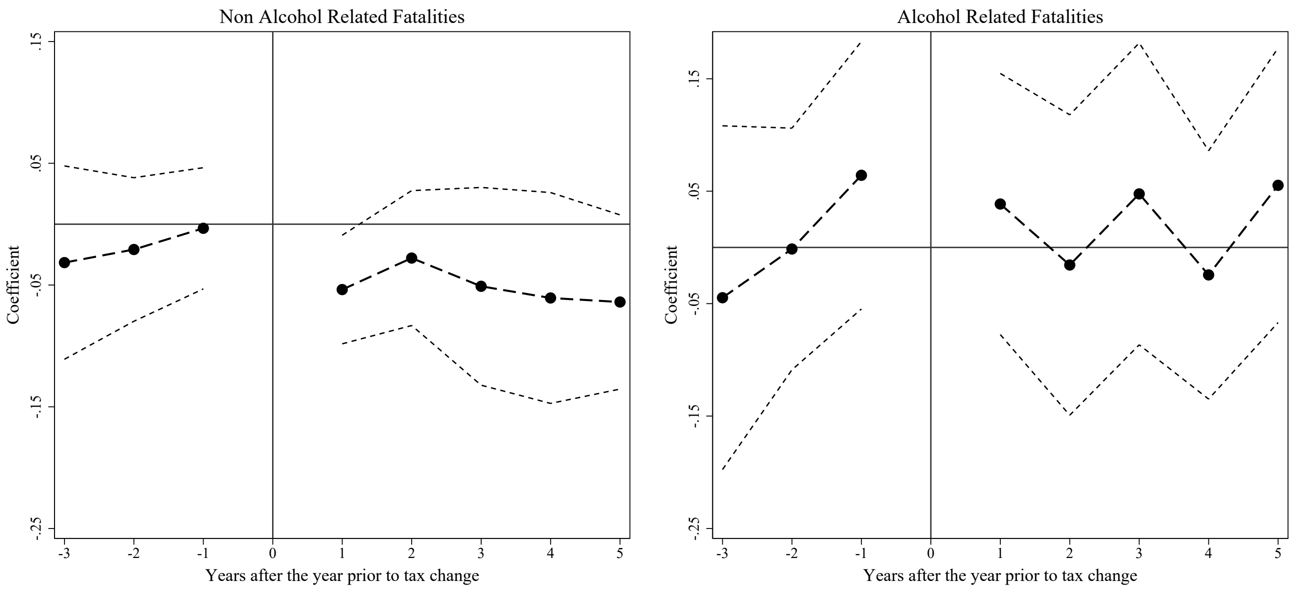
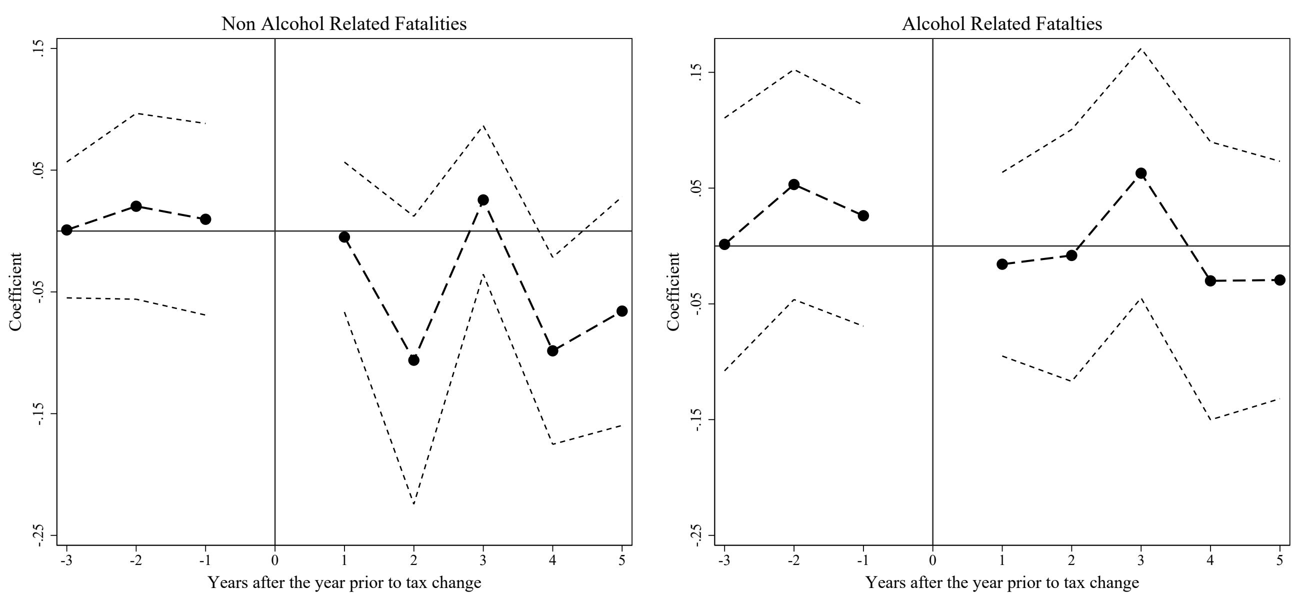


Figure 1: Changes in Real Cigarette Taxes (between 1998 and 2006) in 2013 dollars
Data Source: Author's calculation from the Tax Burden on Tobacco.

Figure 2: Data Source: National Highway Traffic Safety Administration (NHTSA) and The Tax Burdern on Tobacco (Volume 49, 2014)



(a) 16 to 20 year olds



(b) 26 to 30 year olds

Figure 3: Figure (a) pertains to 16-20 year olds and Figure (b) refers to 26-30 year olds. Coefficients are plotted after estimating equation (5).
Data Source: National Highway Traffic Safety Administration (NHTSA) and The Tax Burdern on Tobacco (Volume 49, 2014).

	(1) 1998-2006 mean	sd
Non Alcohol Related Fatalities (16 to 20)	117.54	116.53
Alcohol Related Fatalities (16 to 20)	35.07	36.34
Non Alcohol Related Fatalities (26 to 30)	76.36	82.24
Alcohol Related Fatalities (26 to 30)	38.15	40.75
Real Cigarette Prices (2013 $)	4.13	0.91
Real Cigarette Taxes (2013 $)	0.71	0.53
Smoking Ban in Bars	0.06	0.24
Beer Taxes (2013 $)	0.35	0.31
Log of Population (16 to 20 year olds)	12.43	1.00
Vertical ID Law	0.36	0.48
BAC 0.08 percent	0.62	0.49
Sunday Alcohol Sales Ban	0.32	0.47
Minimum Wage (2013 $)	7.03	0.74
Per capital Income (in 1,000 of 2013$)	39.71	6.43
Log Volume of Gasoline Taxed	14.55	1.02
Seatbelt Law	0.63	0.48
Gasoline Tax In Cents (2013 $)	26.28	6.32
Unemployment Rate	4.70	1.16
N	459	

Table 1: **Summary Statistics.**

	(1) Non-Alcohol 16-20	(2) Alcohol 16-20	(3) Non-Alcohol 26-30	(4) Alcohol 26-30
Real cigarette taxes, 2013 dollars	-0.013	0.004	-0.006	-0.003
	(0.005)	(0.008)	(0.009)	(0.009)
	[0.0319]	[0.8606]	[0.7570]	[0.8606]
Observations	459	459	459	459

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: **Cigarette Taxes and Driving Fatalities (16-20 and 26-30 year olds).** Columns (1) and (2) pertain to 16 to 20 year olds and Columns (3) and (4) represent estimates for 26 to 30 year olds. The specifications control for real beer taxes (in 2013 dollar), log of real percapita income (in 2013 dollar), blood alcohol concentration of 0.08 percent, real gas taxes (in 2013 dollar), real minimum wage, log of 16 to 20 year olds, smoking ban in bars, Sunday alcohol sales ban, vertical ID law, seatbelt law, minimum wage, unemployment rate (from the Bureau of Labor Statistics), the log of population (age-specific) and the log of the volume of gasoline subject to taxation. Additionally, all models include state and year fixed effects along with state specific linear time trends. Standard errors are clustered at the state level. In order to correct for Family Wise Error Rate from the multiple hypotheses testing, Romano and Wolf p-values adjusted for four hypotheses (coefficients on cigarette taxes) are presented inside the square brackets. Significance levels are based on Romano and Wolf p-values.

Appendix

	(1) Non-Alcohol 16-20	(2) Alcohol 16-20	(3) Non-Alcohol 26-30	(4) Alcohol 26-30
Indicator-3*tax change	-0.032	-0.045	0.001	0.001
	(0.040)	(0.076)	(0.028)	(0.054)
Indicator-2*tax change	-0.021	-0.001	0.020	0.053
	(0.029)	(0.054)	(0.038)	(0.049)
Indicator-1*tax change	-0.003	0.064	0.010	0.026
	(0.025)	(0.059)	(0.039)	(0.048)
Indicator1*tax change	-0.054**	0.039	-0.005	-0.016
	(0.022)	(0.058)	(0.031)	(0.039)
Indicator2*tax change	-0.028	-0.016	-0.106*	-0.008
	(0.028)	(0.066)	(0.059)	(0.054)
Indicator3*tax change	-0.051	0.048	0.026	0.063
	(0.040)	(0.067)	(0.030)	(0.054)
Indicator4*tax change	-0.061	-0.024	-0.098**	-0.030
	(0.043)	(0.055)	(0.038)	(0.060)
Indicator5*tax change	-0.064*	0.055	-0.066	-0.029
	(0.036)	(0.061)	(0.047)	(0.051)
Observations	459	459	459	459

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: **Cigarette Taxes and Driving Fatalities – Event Study (16-20 and 26-30 year olds).** The results are obtained from estimating specification 5. The omitted category is the year prior to the tax change year. Columns (1) and (2) pertain to 16 to 20 year olds and Columns (3) and (4) represent estimates for 26 to 30 year olds. The specifications control for real beer taxes (in 2013 dollar), log of real percapita income (in 2013 dollar), blood alcohol concentration of 0.08 percent, real gas taxes (in 2013 dollar), real minimum wage, log of 16 to 20 year olds, smoking ban in bars, Sunday alcohol sales ban, vertical ID law, seatbelt law, minimum wage, unemployment rate, the log of population (age-specific) and the log of the volume of gasoline subject to taxation. Additionally, all models include state and year fixed effects. Standard errors are clustered at the state level.

	(1) Non-Alcohol 16-20	(2) Alcohol 16-20	(3) Non-Alcohol 26-30	(4) Alcohol 26-30
Real cigarette prices, 2013 dollars	-0.0124 (0.0050) [0.0159]	0.0029 (0.0085) [0.8327]	-0.0037 (0.0077) [0.8327]	0.0077 (0.0072) [0.6135]
Observations	459	459	459	459

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: **Cigarette Prices and Driving Fatalities (16-20 and 26-30 year olds).** Columns (1) and (2) pertain to 16 to 20 year olds and Columns (3) and (4) represent estimates for 26 to 30 year olds. The specifications control for real beer taxes (in 2013 dollar), log of real percapita income (in 2013 dollar), blood alcohol concentration of 0.08 percent, real gas taxes (in 2013 dollar), real minimum wage, log of 16 to 20 year olds, smoking ban in bars, Sunday alcohol sales ban, vertical ID law, seatbelt law, minimum wage, unemployment rate, the log of population (age-specific) and the log of the volume of gasoline subject to taxation. Additionally, all models include state and year fixed effects along with state specific linear time trends. Standard errors are clustered at the state level. In order to correct for Family Wise Error Rate from the multiple hypotheses testing, Romano and Wolf p-values adjusted for four hypotheses (coefficients on cigarette taxes) are presented inside the square brackets. Significance levels are based on Romano and Wolf p-values.