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Alcohol-impaired motor vehicle crash risk and the location of alcohol purchase

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ABSTRACT

Motor vehicle crashes involving alcohol impairment are among the leading causes of mortality and morbidity in the U.S. In this study, we examine how the probability of driving after a binge-drinking episode varies with the location of consumption and type of alcohol consumed. We also investigate the relationship between the location of alcohol purchase and the number of alcohol-impaired fatal motor vehicle crashes. Using multiple datasets that are representative of the U.S. between 2003 and 2009, we find that binge-drinkers are significantly more likely to drive after consuming alcohol at establishments that sell alcohol for on-premises consumption, e.g., from bars or restaurants, particularly after drinking beer. Further, per capita sales of alcohol for off-premises consumption are unrelated to the rate of alcohol-impaired fatal motor vehicle crashes. When disaggregating alcohol types, per capita sales of beer for off-premises consumption are negatively associated with the rate of alcohol-impaired fatal motor vehicle crashes. In contrast, total per capita sales of alcohol from all establishments (on- and off-premises) are positively related to the rate of alcohol-impaired fatal motor vehicle crashes and the magnitude of this relationship is strongest for beer sales. Thus, policies that shift consumption away from bars and restaurants could lead to a decline in the number of motor vehicle crashes.

1. Introduction

Unintentional motor vehicle crashes are a leading cause of mortality and morbidity in the U.S. In 2005, the latest year for which cost reports are available, there were 43,667 deaths attributable to fatal crashes, resulting in an estimated total cost of $49.5 billion. In the same year, motor vehicle crashes resulted in 218,554 hospitalizations, totaling $26.3 billion in medical expenditures and lost work productivity (Centers for Disease Control and Prevention, 2013a).

Numerous studies have documented a positive relationship between the amount of alcohol consumed and the risk of causing a motor vehicle crash (Anda et al., 1988; Borkenstein et al., 1964; Corrao et al., 1999; Fabbri et al., 2001; Taylor and Rehm, 2012; Taylor et al., 2010; Zador et al., 2000). In 2010, nearly one-third of the 32,885 deaths from fatal motor vehicle crashes involved a driver impaired by alcohol (National Highway Traffic Safety Administration, 2010). Moreover, of the 43,731 acute alcohol-related deaths per year in the U.S. between 2001 and 2005, 13,810 were attributable to motor vehicle crashes. Reducing the number of drunk-driving fatalities is therefore a major public health priority in the United States.

Several authors have noted that the location of alcohol consumption plays an important role in determining the overall risk of a fatal motor vehicle crash (Cotti and Tefft, 2011; Manning et al., 1989; Ruhm, 1995). For example, the decline in fatal motor vehicle crashes in the U.S. following the 2008 financial crisis was partly attributable to a decline in the number of miles driven (Cotti and Tefft, 2011). Naimi et al. (2009) find that driving after a binge drinking event was substantially more likely when the event occurred in a bar or club as compared to the drinker's home. A related study found that two-thirds of individuals who reported driving after a binge drinking event also reported that beer was the

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predominant type of alcohol consumed (Naimi et al., 2007). Yet, to our knowledge, no studies have examined how consumption location and type of alcohol consumed influence drunk driving risk simultaneously. More importantly, no studies have directly linked consumption location to the number of alcohol-impaired motor vehicle crashes. This is an important gap in the current literature, as effective policy design requires information about the roles that quantity consumed, type of alcohol consumed, and location of consumption each play in determining crash incidence.

Therefore, this study seeks to quantify the effect of *on-premises consumption* (e.g., at bars and restaurants) relative to *off-premises consumption* (e.g., purchases from supermarkets, convenience stores and liquor stores) on two outcomes: the probability of driving after a binge-drinking episode and the number of fatal motor vehicle crashes. Further, it investigates how these relationships vary by the type of alcohol purchased.

The results from this study can inform important policy debates. For example, one proposal to reduce alcohol-impaired motor vehicle crashes would increase the alcohol excise tax to reduce total consumption of alcohol (Baker et al., 2012). If the consumption of alcohol purchased for on-premises consumption was primarily responsible for causing fatal motor vehicle crashes, however, then a more targeted approach that only increased the tax on alcohol purchased at bars, restaurants, and other on-premises establishments may provide more net social welfare, i.e., reduce an equivalent number of crashes while taxing fewer individuals. These questions cannot be adequately addressed given existing research that has largely ignored the role of consumption location.

2. Methods

The relationship between location of alcohol consumption and motor vehicle crash risk will be examined in two separate analyses. First, we will utilize individual-level data to study the relationship between the location of consumption, the type of alcohol consumed and the probability of driving after a binge-drinking event. Second, we will utilize aggregate data at the state- and market-level to study the relationship between consumption location, alcohol type, and the alcohol-impaired motor vehicle crash rate. All datasets include de-identified observations and are publicly available unless otherwise specified.

2.1. Location of consumption and driving after binge-drinking

2.1.1. Data

We examine the relationship between the location of alcohol consumption, alcohol type, and the probability of driving after a binge-drinking episode using data drawn from the 2003, 2004, and 2008 surveys of the Behavioral Risk Factor Surveillance System (BRFSS), the three survey years that included a Binge Drinking module (Centers for Disease Control and Prevention, 2013b). The 2003 and 2004 BRFSS Binge Drinking modules have been used previously to study the relationship between driving and binge drinking both by the location of consumption (Naimi et al., 2009) and by alcohol subtype (Naimi et al., 2007). This portion of our analysis therefore serves to confirm earlier findings by extending the data to include the more recent 2008 survey and to present results that simultaneously consider consumption location and alcohol type, which foreshadow results from our market- and state-level analyses.

Across the three survey years, respondents in 22 states participated in the Binge Drinking module. We first record the quantity of each category of alcohol consumed at the last binge drinking occasion from responses to the following three questions:

During the most recent occasion when you had 5 or more alcoholic beverages, about how many [beers, including malt liquor | glasses of wine, including wine coolers, hard lemonade, or hard cider | liquor, including cocktails], did you drink?

In 2008, the questions were revised so that the number of wine drinks was recorded separately from wine coolers, etc. We summed those separately recorded values to be comparable with the earlier measures. As discussed later, our regression results were robust to various methods of controlling for the difference in module structure, including the omission of responses from the 2008 module.

The primary location of where the binge-drinking event occurred is obtained from the question:

During this most recent occasion, where were you when you did most of your drinking?

1 *At your home, for example, your house, apartment, condominium, or dorm room*
2 *At another person's home*
3 *At a restaurant or banquet hall*
4 *At a bar or club*
5 *At a public place, such as at a park, concert, or sporting event*
6 *Other*

Consumption at home or at another home is categorized as consumption of alcohol purchased from off-premises establishments. Consumption at a bar, restaurant, or public place is categorized as consumption of alcohol purchased from on-premises establishments. Although we categorize consumption at a public place as on-premises, the presented results are qualitatively similar when doing the opposite. We also separately consider predicted probabilities for each sub-category of consumption location.

The quantity and location of alcohol consumption is linked to reported driving behavior using responses to the question:

Did you drive a motor vehicle, such as a car, truck, or motorcycle during or within a couple of hours after this occasion?

In addition to Binge Drinking module responses, we include several demographic and economic characteristics as control variables in the analysis. These include respondent age and indicator variables for the following characteristics: male; race/ethnicity (white, black, Hispanic); education level (high school graduate, some college education, college graduate); marital status; income categories; employment status; and state-by-year beer excise taxes (The Beer Institute, 2010). Finally, in all estimation models we weight each response by the number of times the respondent reported binge drinking in the 30 days prior to interview, as recorded in the *Alcohol Consumption* section of the standard core questionnaire, though it is worth noting that results were qualitatively similar when observations were unweighted.

2.1.2. Statistical analysis

To study associations between self-reported binge drinking location, alcohol consumption and driving behavior, a series of probit models are estimated. In each case, whether a respondent reports driving in the hours following after a binge drinking event is regressed on drinking location and alcohol quantity/type according to the following general model:

$$g(E(d_i)) = \beta_0 + l_i\beta_l + \alpha_i\beta_a + X_i\beta_X \quad (1)$$

where d_i indicates whether a respondent reports driving; l_i is a vector of indicators for the location of alcohol consumption; a_i is a