Published in final edited form as:

Health Econ. 2016 July ; 25(7): 816–828. doi:10.1002/hec.3186.

A BEHAVIORAL ECONOMIC MODEL OF ALCOHOL ADVERTISING AND PRICE

HENRY SAFFER^{a,*}, DHAVAL DAVE^{a,b}, and MICHAEL GROSSMAN^{a,c}

^aNBER, New York, NY, USA

^bDepartment of Economics, Bentley College, Waltham, MA, USA

^cEconomics Department, Graduate Center, CUNY, New York, NY

SUMMARY

This paper presents a new empirical study of the effects of televised alcohol advertising and alcohol price on alcohol consumption. A novel feature of this study is that the empirical work is guided by insights from behavioral economic theory. Unlike the theory used in most prior studies, this theory predicts that restriction on alcohol advertising on TV would be more effective in reducing consumption for individuals with high consumption levels but less effective for individuals with low consumption levels. The estimation work employs data from the National Longitudinal Survey of Youth, and the empirical model is estimated with quantile regressions. The results show that advertising has a small positive effect on consumption and that this effect is relatively larger at high consumption levels. The continuing importance of alcohol taxes is also supported. Education is employed as a proxy for self-regulation, and the results are consistent with this assumption. The key conclusion is that restrictions on alcohol advertising on TV would have a small negative effect on drinking, and this effect would be larger for heavy drinkers.

Keywords

alcohol advertising; behavioral economics

1. INTRODUCTION

The importance of studying alcohol advertising is highlighted by the costs of alcohol abuse. The costs of alcohol abuse result from a variety of damages that individuals inflict on themselves and others. Alcohol-related deaths make alcohol the third leading cause of preventable death in the USA (Mokdad *et al.*, 2004). Approximately 27,000 deaths per year are from liver cirrhosis. Another 25,000 deaths are the result of fatal motor vehicle accidents where one or more of the drivers involved had been drinking. Alcohol is also a major risk factor in morbidity including heart disease and various cancers. Alcohol also plays a major role in nonfatal accidents, violent crime, poor birth outcomes, marital instability, and unemployment. Finally, alcohol imposes significant economic costs in the USA. Bouchery *et al.* (2011) estimated the economic cost of excessive drinking was \$223.5bn in 2006 or

*Correspondence to: NBER, 365 Fifth Ave, New York, NY 10016, USA. ; Email: hsaffer@gc.cuny.edu

approximately \$1.90 per alcoholic drink. Control of alcohol abuse is a justifiable goal of public policy because much of the cost of alcohol abuse is paid by the state or by individuals who did not inflict the damage.

Alcohol advertising on TV in the USA is substantial and may increase the cost of alcohol abuse. The advertising-to-sales ratio for alcohol is about 5%, while the typical industry advertising-to-sales ratio is about 2% to 3% (Schonfeld and Associates 2012). Data from Kantar Media show that alcohol advertising on TV was about \$1.1bn in 2009 and did not change much between 2002 and 2009. However, spirits advertising on TV has been a major growth area. According to Schonfeld and Associates (2012), the advertising-to-sale ratio, in all media, for spirits and blended liquors was 14.3. This large ratio comes mainly from the use of TV. Under the terms that ended Prohibition, spirits producers voluntarily agreed to not use broadcast media for advertising. However, in 1996, the spirits industry abandoned this voluntary agreement and placed ads on cable TV stations. At that time, the four largest broadcasters, ABC, CBS, Fox, and NBC, refused to run ads for spirits. Gradually, local stations affiliated with NBC and CBS have been accepting spirits ads placed after 10 PM.

Alcohol prices are another important determinant of alcohol use. Alcohol prices vary across the country, although there has been little change in real prices over the past 10 years. Federal alcohol excise taxes have not changed since 1991. At the state level, there have been a number of small tax changes amounting to only a few cents per gallon. Data from the Bureau of Labor Statistics show that alcohol prices for at home consumption increased by about 33% from 1999 to 2011. Because the overall consumer price index (CPI) increased by about 30% during this period, there has been little recent change in the real price of alcohol for at home consumption.

2. PRIOR STUDIES

There are a growing number of studies in the economics literature, experimental literature, and public health literature on the effects of alcohol ads on alcohol consumption. However, no prior studies in the economics literature and few studies in the overall literature provide any information on potential differential effects by consumption level. A review of economics studies by Gallet (2007) examined 132 studies of alcohol demand that included an advertising measure. Gallet (2007) reports a mean value for the advertising elasticity of 0.03. The studies in the review do not distinguish the effects of advertising on heavy drinkers from the effects of advertising on moderate drinkers. Because most drinkers are in the moderate category, the failure to distinguish individuals by consumption level may mask the effect of advertising on heavy drinkers.

The experimental literature provides a stronger consensus for a positive effect of alcohol advertising than the economics literature.¹ Engels *et al.* (2009) tested experimentally whether portrayal of alcohol images in movies and commercials on television promotes actual drinking. They let young adult men watch a movie clip with two commercial breaks.

¹Although there are a number of studies in the public health literature that find positive effects of alcohol advertising, Nelson (2010, 2011) argues that these studies do not establish a causal interpretation between advertising and consumption.

The subjects were allowed to drink nonalcoholic and alcoholic beverages. These participants were randomly assigned to one of four groups defined by increasing levels of exposure to alcohol portrayals. The participants assigned to the conditions with most alcohol portrayals in either movies or commercials consumed on average 1.5 glasses more than those in the condition with no alcohol portrayals. A few experimental studies have looked for differences in the effect of advertising by consumption level. An experimental study by Koordeman *et al* (2011) found that alcohol commercials prior to a movie led to increased consumption of alcohol, but only in heavy drinkers. Consistent with these results, McCusker (2001) found that memories of positive drinking outcomes are more accessible for heavy compared with moderate drinkers, and Tapert *et al* (2003) found that alcohol advertising leads to distinct patterns of brain activation, causing craving responses and affecting consumption decisions in heavy drinkers.

There are a number of studies in the literature on the effect of alcohol price on alcohol consumption. Gallet (2007) reports a mean value for the price elasticity of -0.535 . Prior studies that examined heavy drinking found lower elasticities than those estimated for per capita drinking. A review by Wagenaar *et al* (2009) reports a mean alcohol price elasticity of -0.51 for all drinking and a mean price elasticity of -0.28 for heavy drinking. An and Sturm (2011) also show that moderate drinkers have a more price elastic demand than heavy drinkers. They use the state beer tax as the price variable and include over 4.6 million individuals from 26 waves of the Behavioral Risk Factor Surveillance Survey. Although they estimate regressions for different drinking levels with ordinary least squares, which can create bias because of selection based on the dependent variable, the very large sample size and use of tax data add validity to this study. One prior study of alcohol price effects is of particular interest because it employs an empirical strategy similar to the strategy adopted in this paper. Manning *et al* (1995) employ a quantile approach that bypasses selection on the dependent variable and simply requires definition of the quantiles. They use the National Health Interview Survey with a weighted average of beer, wine, and spirits prices and a two-part model that separates the dichotomous drinking participation decision (intensive margin) from the choice of quantity consumed given participation (extensive margin). The price variable in the participation equation is significant, while it is not in the consumption given participation equation. The results show that the moderate drinkers have the highest price elasticity, which is -1.19 . The price elasticity declines as consumption increases from the median quantile. The price is insignificant in the quantile that includes the heaviest drinkers, while all other quantiles are significant.

3. THEORY

The theory that is the basis of the empirical work begins with a standard demand curve for alcohol. Additional predictions regarding advertising and price effects are derived from a behavioral economic theory of addiction and response to cues based on neurological evidence provided by Bernheim and Rangel (2004). The behavioral economic theory provides an advance in understanding how advertising affects alcohol consumption decisions and provides specific empirical predictions. This theory is based on two key points. First, the theory argues that the role of advertising cues on alcohol consumption is a consequence of the forecast of a hedonic effect from alcohol, rather than the hedonic effect itself.² This is

sometimes referred to as Pavlovian conditioning. Second, the theory argues that the forecasted hedonic effect produced by advertising cues increases as consumption increases.

The behavioral economic theory employed in this paper assumes a convenient fiction of three distinct neurological systems, which act simultaneously to produce a single decision. These neurological systems will be referred to as the Heuristic system, the Rational system, and the Governor system. The Heuristic system is a subconscious system for learning correlations between current conditions, decisions, and short-term rewards. The Heuristic system is efficient at learning simple action-reward correlations, but it can only learn about a limited range of near-term consequences. The Rational system develops causal models of the world and reasons out the longer term implications of different choices. The Rational system needs time and cognitive resources to reason and make a choice. The Rational system addresses the shortcomings of the Heuristic system but is comparatively slow and energy intensive. Self-regulation is a process that refers to the Governor system's ability to suppress the Heuristic system in favor of the Rational system and is related to the concept of time preference for the future.

There is an important distinction between nonaddictive consumption goods and addictive consumption goods in how the Heuristic system learns. Individuals make consumption choices based in part on consumption experiences. When an individual consumes a nonaddictive good, there will be a post-consumption experience, which then updates the Heuristic system. That is, there is learning from the post-consumption experience, and the predicted result of a future choice reflects this learning. However, the consumption of the addictive good affects the Heuristic system both through the post-consumption effect and through a direct chemical effect, which distorts the learning process. The Heuristic system functions with systematically skewed information, which leads to mistakes in decision-making. An individual can suppress the Heuristic system by exercising self-regulation but cannot consciously eliminate the desire generated by the Heuristic system. The Governor system regulates total consumption, but individual differences in self-regulation and individual biological differences in the direct effect of alcohol on Heuristic learning may partly explain why some individuals become heavy drinkers while others drink alcohol without excess Hull and Slone (2004).

External cues associated with consumption can produce a forecast of the hedonic effect, which is separate from the actual hedonic effect. Alcohol advertising on TV is an example of an external cue. Bernheim and Rangel (2004) report on a series of neuroscience experiments on cues and the level of hedonic forecasts. Hedonic forecasting occurs as a result of activity in a certain part of the brain and is distinct from the hedonic experience itself. In these experiments, when subjects are presented with a cue followed by a reward, there is a corresponding level of neural activity. However, as experience with the reward continues, this neural activity occurs in response to the cue rather than the reward. When the reward is increased, but the cue remains constant, the neural activity increases in proportion to the new

²The hedonic effect refers to the utility or pleasure derived from alcohol consumption, and the hedonic forecast is the forecast of how much utility or pleasure will result from alcohol consumption. Individuals who experience a negative effect from alcohol consumption are less likely to become alcohol consumers.

level of reward. That is, the hedonic forecast is proportional to the individual's usual consumption rather than proportional to the level of the cue.

The Rational system responds to price information and longer term health expectations. For individuals who are heavy drinkers, the hedonic forecast will be larger and the Governor system will be less able to suppress the Heuristic system in favor of the Rational system. This means that heavy drinkers will have a smaller consumption response to a price increase than moderate drinkers. That is, heavy drinkers will have a lower price elasticity than moderate drinkers. However, greater self-regulation can shift the balance toward the Rational system and increase the price elasticity. If the Heuristic system were totally suppressed, then consumers could fully account for the future consequences of their current alcohol consumption. This is the Rational Addiction model of Becker *et al* (1991).

The empirical demand model can be expressed as

$$C_i = \lambda_1 A + \lambda_2 P + \lambda_3 X_i + u_i \quad (1)$$

where C_i is consumption, A is advertising, P is price, X_i are other variables affecting consumption, and u_i is a random error term. In neoclassical theory, advertising can be included in the demand function as an information variable. However, in behavioral economic theory, advertising is a cue that induces Heuristic consumption. The coefficients in Equation (1) are dependent on the balance between the Heuristic system and the Rational system and are partially dependent on the individual's usual consumption level. The empirical predictions are that (i) alcohol advertising will produce a greater response in heavy drinkers than is produced in moderate drinkers, (ii) heavy drinkers will be less price responsive than moderate drinkers, and (iii) greater self-regulation will reduce the response to advertising and increase the response to price.

4. DATA

The working data set is based on data from the National Longitudinal Survey of Youth 1997 (NLSY97), which is an annual longitudinal, nationally representative sample of 8984 individuals who were 12 to 16 years old as of December 31, 1996. The working data set includes data from 2002 to 2009, and therefore, the individuals are from 18 to 29 years of age. This age group is particularly important to study because this group has higher alcohol consumption and alcohol-related fatalities than the general population. Because the log of alcohol consumption is employed as the dependent variable, only individuals with positive alcohol consumption are included in each year. Alcohol price and advertising data were merged to the NLSY97 data set, and the mean values and standard deviations for all the variables employed in the regression are presented in Table I.

The NLSY97 data provide several measures of alcohol consumption and relevant economic and demographic measures. The alcohol consumption variable is based on two consumption measures. The first measure is the number of days in the past 30 days that alcohol was consumed (drinking days per month). The second measure is the usual number of drinks

consumed per day in the past 30 days (drinks per day). The empirical consumption variable is the product of these two variables and is the number of drinks per month. Individuals who do not currently drink are excluded because this is a different decision process. The independent variables from the NLSY97 measure economic, demographic, and other factors that may impact alcohol consumption. These variables include continuous measures of the respondent's age, income, and education. These variables are included in the demand function based on theory and prior studies. Income was divided by the 1983 CPI to create real income. Real income was then scaled by dividing by 100. Also included are dichotomous measures of the respondent's gender, race, Hispanic ethnicity, school enrollment status, and marital status. All of the regressions include year fixed effects and local fixed effects referred to as designated market area (DMA) fixed effects. A DMA is an advertising market and is similar to a Metropolitan Statistical Area.³ There are typically more than one DMA in each of the included states in the NLSY97 data set.

The TV advertising data were purchased from Kantar Media and include hours of alcohol ads per month on all local and national TV. The reliability of these data is widely recognized in the advertising industry. All of the data reported by Kantar Media are independent estimates and do not use any information from alcohol producers. The data are collected by monitoring the media, from station reports and advertising wholesalers' reports. The ad variable data were divided by 30 to approximate average hours per day of alcohol advertising and converted to its natural log. Local TV advertising includes data from the top 101 local markets, and national TV includes Network TV, Syndicated TV, and Cable network TV. Spanish Language TV was excluded because it has a limited audience. The top 101 DMAs account for about 82% of the US population. National ads have no local variation but have monthly and yearly variation. The local advertising and the national advertising were added together to create total advertising, which has local, monthly, and yearly variation. The empirical advertising variable was appended to the NLSY97 data set by DMA, month, and year. That is, advertising is matched to the individual by the month and year of interview and by the individual's DMA of residence. All individuals in the same market, month, and year get the same value of total alcohol advertising. Larger values of the advertising variable indicate an increased probability of exposure to alcohol advertising.

Additional data on advertising by DMA and year are presented in Figures 1 and 2. Figure 1 shows the advertising data by DMA averaged over the years 2002 to 2009. The mean advertising level is 2.43 with a standard deviation of 0.22 and coefficient of variation of 0.09. This relatively low coefficient of variation reflects the inclusion of national advertising, which has no DMA variation. National advertising cannot be targeted by DMA. Figure 2 shows the advertising data by year averaged over all DMAs. In this case, the mean is 2.45 with a standard deviation of 0.49 and a coefficient of variation of 0.20. These data indicate a clear upward trend in TV alcohol ads over time. To further investigate the variation in the advertising variable, a regression of advertising on year and DMA fixed effects was estimated. Almost all the fixed effects coefficients were significant at the 5% level or better. The R-square from this regression was only 0.25, which indicates that there is considerable

³Designated market area is a widely used concept in the advertising industry.

variation in advertising unexplained by year and market fixed effects alone. There is very little variation in real price over time and across markets.

The simple relationship between advertising and the distribution of consumption is illustrated in Figure 3. This figure presents two kernel distributions of the $\ln$ of alcohol consumption for drinkers. The distribution displayed with a solid line presents consumption in DMAs with above average advertising, and the distribution displayed with a dashed line presents consumption in DMAs with below average advertising. At low levels of consumption, the two distributions largely overlap. However, above the mean consumption, consumption in high advertising DMAs is higher than consumption in low advertising DMAs. This suggests that advertising effects are minimal at low consumption levels but more pronounced at high consumption levels. The quantile regressions presented in the succeeding text further investigate this relationship.

Alcohol advertisers would prefer to place ads in media which have audiences consisting mainly of drinkers. This phenomenon is referred to as targeted advertising. It is difficult for alcohol advertisers using TV to target drinkers because of the relatively diverse audiences, which are reached by TV, and the high prevalence of alcohol consumption across the general population. About 70% of individuals in their low 20s are drinkers, and this percentage is slightly higher for men and whites and declines with age. This makes TV an excellent medium for advertising of alcohol by focusing on shows with strong appeal to young, white men. However, alcohol advertising on TV cannot be targeted any more precisely than by the demographics of age, gender, race, and Hispanic ethnicity. The inclusion of these demographic variables in all the regressions controls this targeting.

The real alcohol price was created from data from the Council for Community and Economic Research (C2ER).⁴ These data are reported at the quarterly level for about 300 communities. The C2ER data employed were the price of a six pack of Heineken and the price of a 1.5-L bottle of Livingston Cellars, Gallo Chablis, or Chenin Blanc, less any deposit. Both alcohol prices were converted to the price per liter of pure ethanol. These two prices were then weighted by their relative consumption on a national level.⁵ Prices were converted to real by dividing by the national CPI. These data were aggregated to the state level, which reduces measurement error associated with a small number of observations in each community. Ruhm *et al* (2012) argue that the price for the single brand of beer and the single brand of wine collected by C2ER does not reflect the prices paid by the typical drinker, and thus, the C2ER data have measurement error. They argue that the Universal Product Code or scanner data from grocery stores collected by SymphonyIRI are better price measures than the C2ER price data. The lack of spirits price data in the C2ER data can also result in overstating the alcohol price effect. The price variable created with the C2ER data is also highly correlated with DMA and year fixed effects. Both the C2ER price data and the

⁴Council for Community and Economic Research was formally known as the American Chamber of Commerce Researcher Association.

⁵The formula used to compute the alcohol price is $[0.71 * (\text{beer price})/2.13/0.05] + [0.29 * (\text{wine price})/1.5/0.11]$. The values 0.71 and 0.29 are the national level shares for beer and wine consumption only. The value 2.13 is the number of liters in a six pack, and the value 1.5 represents the fact that the wine price is for a 1.5-L bottle. The values 0.05 and 0.11 represent the percent ethanol in each beverage, respectively.

scanner data for beer prices were appended to the NLSY97 data set by state and quarter. Regressions on alcohol consumption, given participation, with the scanner price data and without DMA fixed effects, never resulted in a significant price coefficient. Ruhm *et al* (2012) use this scanner data and controlling for region rather than state and report one significant and two insignificant beer price coefficients. Regressions on alcohol consumption, given participation, with the C2ER price data, without state fixed effects, resulted in several significant price coefficients. Although the goal of this paper is primarily to examine advertising effects, the inclusion of a price variable in the demand function is important. The choice of data to measure alcohol price remains problematic. However, because the C2ER data produced some reasonable and significant price effects, these results are reported in this paper rather than the scanner price results.⁶ The natural log of alcohol price is employed in the regressions.

5. RESULTS

The goal of the empirical work is to estimate λ_1 and λ_2 from Equation (1) at different levels of consumption. Quantile estimation is ideally suited to this empirical problem because quantile regressions provide estimates of the effects of the independent variables for a pre-specified set of quantiles of the dependent variable. These quantiles are simply percentiles of the dependent variable. The quantile regression estimator, for each quantile, uses all of the sample observations and thus does not require sample stratification. The consumption and price variables are in natural logarithmic form, and therefore, the resulting estimates are elasticities at the intensive consumption margin. The empirical model includes demographic variables as controls for individual heterogeneity. Standard errors clustered at the state level were employed in all specifications.⁷ The quantile regressions include bootstrap standard errors based on 400 repetitions. All empirical models include year fixed effects to control for national level time changes.

The alcohol advertising coefficients presented in Table II are all positive and significant. All but one of the advertising elasticities reported in Table II are greater than the average of 0.03 reported by Gallet (2007). One reason for this is that the elasticities in Table II are estimated for drinkers only. If all individuals were included, then the estimated advertising elasticities would be lower. The elasticities reported in Table II generally increase as alcohol consumption increases. The magnitude of the increase is small but statistically significant for tests of a difference across five or more quantiles. The advertising elasticity at the 80th quantile is about three times the advertising elasticity at the 10th quantile. These results support the prediction of the behavioral theory that heavy drinkers are more responsive to alcohol advertising.

Other variables in Table II include age and age squared variables which suggest that alcohol consumption increases at a decreasing rate by age for the sample. The effect of income is positive and significant in the 10th through the 60th quantiles. This suggests that at low levels of alcohol consumption, alcohol is a normal good. At high levels of alcohol consumption,

⁶The alcohol advertising coefficients were robust with respect to the choice of price variable.

⁷Clustering at the state level accounts for all correlations across individuals in the same state, while clustering at the individual level only accounts for correlations within a single individual.

the normal good effect of alcohol is offset by the normal good aspect of health. The demographic variables, Black, Hispanic, and Married, are all negative and significant. Male is positive and significant all quantiles. Education has a negative and significant effect on consumption in all but one quantile. Enrolled has a negative effect on alcohol consumption but is significant in only two quantiles.

The price coefficients in Table II are negative and mostly insignificant. There is no evidence that these co-efficients trend downward at higher levels of alcohol consumption as suggested by the theory. The lack of significance is likely due to the limited time variation, within DMA, in the alcohol price data. A regression of alcohol price on the DMA and year fixed effects variables only resulted in an R-square of .65 which indicates that the inclusion of DMA fixed effects variables in the demand equation duplicate the variation in price and increase the likelihood of insignificant price coefficients. However, the DMA fixed effects variables are important to control for unobserved DMA level variables which could bias the results if omitted.⁸

Table III presents an alternative specification to further examine the effects of the DMA fixed effects variables on the price coefficients. This alternative specification is the same quantile regression as Table II but without DMA fixed effects. The bias introduced by excluding the DMA fixed effects can be gauged by comparing the nonprice coefficients in the regression in Table III to those of Table II. There is very little difference in sign and significance for all of the nonprice coefficients in Tables II and III. The difference in the magnitude of the coefficients in the two tables reflects the bias due to omitted DMA fixed effects in Table III. However, all of the corresponding nonprice coefficients, and importantly, the advertising coefficients, in the two tables are actually relatively close in magnitude. These comparisons show that the omitted DMA fixed effects in Table III do not result in a level of bias that would alter any of the conclusions regarding the nonprice variables.

However, the results for the price variable presented in Tables II and III are very different. In Table II, all of the price coefficients are negative, and two are significant. In Table III, again, all of the price coefficients are negative, and four are significant. Most of the price coefficients fall within the range of price elasticities for alcohol that are reported in the review by Wagenaar *et al* (2009). The differences between the two tables are a reflection of the high correlation between the price variable and the DMA fixed effects. The price coefficients in Table III generally decline as consumption increases, although there is a significant difference only between the 10th and 70th quantiles. These results do not provide strong evidence of a decline in the price elasticity as consumption increases. However, reviews by Gallet (2007) and Wagenaar *et al* (2009) and studies by An and Sturm (2011) and Manning *et al* (1995) do show that price elasticities are lower for heavy drinkers as is predicted by the behavioral model.

Table IV presents an alternative specification to examine the effects of self-regulation on the advertising elasticity. The behavioral theory argues that individuals with greater self-

⁸Individual fixed effects are not employed because theory argues that individual heterogeneity due to different levels of past consumption contributes to differential responses to advertising and price.

regulation will be less responsive to advertising and will be more responsive to price than individuals with less self-regulation. Empirical verification of these assertions is difficult because self-regulation is not an observable construct. However, because prior studies have shown a correlation between education and self-regulation, education was tested as a proxy for self-regulation (Mischel *et al.*, 1988). The test relies on the inclusion of an education–advertising interaction variable. A price interaction variable would also be useful to test the effects of self-regulation on the price elasticity. However, there are already difficulties with price effects as described earlier. The specification in Table IV includes the advertising variable but does not include the education variable. The interaction term increases collinearity making it difficult to include all three variables. The education variable was dropped because the marginal effect of advertising is the focus of interest in this project rather than the marginal effect of education.

The empirical results for education are evaluated by comparison to the theoretical predictions for self-regulation. In Table IV, the marginal effect of advertising is the coefficient of the advertising variable plus the coefficient of the interaction variable times education. The results for this calculation based on the mean level of education are presented in the last row of the table. In Table IV, the interaction coefficient is negative, and the advertising coefficient is positive. Because the interaction term is negative, it lowers the advertising elasticity and the magnitude of this decline increases with the level of education. The advertising elasticities, when evaluated at the mean level of education, are about the same as those reported in Table II. These advertising elasticities also increase as consumption increases. Based on these results, at higher levels of education, the calculated advertising elasticity will be lower. This is consistent with the theoretical prediction for self-regulation. However, these results do not provide evidence that education is a proxy for self-regulation and the exclusion of the education variable may create bias in the coefficient of the interaction term. The results presented in Table IV could also be due to other interpretations of education, such as its role in the demand for health and the demand for alcohol. Thus, these results are not strong evidence of a self-regulation effect but are suggestive. A data set with better measures of self-regulation could provide a more definitive test.

6. CONCLUSIONS

The behavioral economic theory presented in this paper provides a novel empirical prediction regarding the effect of alcohol advertising. Advertising, in neoclassical economics, is information that can change perceptions of the product and act as a complement to consumption. The neoclassical view also argues that the various streams of information about alcohol are rationally weighed, and according to revealed preference, the individual's observed consumption is optimal. Advertising, in behavioral economics, is a cue that can result in consumption greater than that which is rationally desired. Behavioral economics also predicts that price elasticity decreases with the consumption level. This effect has been found in prior empirical studies, but the behavioral economic theory provides a new explanation for this phenomenon.

The results presented in this paper provide empirical support for the predictions of the behavioral economic model. However, the empirical predictions could also have been generated by an alternative theory. The results show that the advertising elasticity trends upward as consumption increases, although the increase is small. The advertising elasticities are larger than those reported in other studies, but this may be due to the exclusion of nondrinkers from the sample. This study provides only weak evidence of a decline in price elasticity as consumption increases. However, evidence of this decline is found in several past studies that strengthen the conclusion that price elasticity declines as consumption increases. The key conclusion is that advertising induced alcohol consumption may not be optimal, especially for heavy drinkers and that the continuing high level of alcohol advertising on TV is not in the interest of public health.

References

- An R, Sturm R. Does the response to alcohol taxes differ across racial/ethnic groups? Some evidence from 1984–2009 behavioral risk factor surveillance system. *The Journal of Mental Health Policy and Economics*. 2011; 14(1):13. [PubMed: 21552394]
- Becker GS, Grossman M, Murphy KM. Rational addiction and the effect of price on consumption. *The American Economic Review*. 1991; 81(2):237–241.
- Bernheim DB, Rangel A. Addiction and cue-triggered decision processes. *American Economic Review*. 2004; 95(5):1558–1590.
- Bouchery EE, Harwood HJ, Sacks JJ, Simon CJ, Brewer RD. Economic costs of excessive alcohol consumption in the US, 2006. *American Journal of Preventive Medicine*. 2011; 41(5):516–524. [PubMed: 22011424]
- Engels RCME, Hermans R, Van Baaren RB, Hollenstein T, Bot SM. Alcohol portrayal on television affects actual drinking behaviour. *Alcohol and Alcoholism*. 2009; 44(3):244–249. [PubMed: 19237443]
- Gallet CA. The demand for alcohol: a meta-analysis of elasticities*. *Australian Journal of Agricultural and Resource Economics*. 2007; 51(2):121–135.
- Hull, JG.; Slone, LB. *Handbook of Self-regulation: Research, Theory, and Applications*. Guilford Press; New York: 2004. Alcohol and self-regulation; p. 466-491.
- Kantar Media. Available from: <http://www.kantarmedia.com/>
- Koordeman R, Anschutz DJ, Engels RCME. Exposure to alcohol commercials in movie theaters affects actual alcohol consumption in young adult high weekly drinkers: an experimental study. *The American Journal on Addictions*. 2011; 20(3):285–291. [PubMed: 21477057]
- Manning WG, Blumberg L, Moulton LH. The demand for alcohol: the differential response to price. *Journal of Health Economics*. 1995; 14(2):123–148. [PubMed: 10154654]
- McCusker CG. Cognitive biases and addiction: an evolution in theory and method. *Addiction*. 2001; 96(1):47–56. [PubMed: 11177519]
- Mischel W, Shoda Y, Peake PK. The nature of adolescent competencies predicted by preschool delay of gratification. *Journal of Personality and Social Psychology*. 1988; 54(4):687. [PubMed: 3367285]
- Mokdad AH, Marks JS, Stroup DF, Gerberding JL. Actual causes of death in the United States, 2000. *JAMA, the Journal of the American Medical Association*. 2004; 291(10):1238–1245. [PubMed: 15010446]
- Ruhm CJ, Jones AS, McGeary KA, Kerr WC, Terza JV, Greenfield TK, Pandian RS. What US data should be used to measure the price elasticity of demand for alcohol? *Journal of Health Economics*. 2012; 31(6)
- Schonfeld & Associates. [20 April 2015] Advertising Ratios & Budgets. 2012. Available from: <http://www.outburstadvertising.com/resources/adtosales.pdf>

- Tapert SF, Cheung EH, Brown GG, Frank LR, Paulus MP, Schweinsburg AD, Meloy MJ, Brown SA. Neural response to alcohol stimuli in adolescents with alcohol use disorder. *Archives of General Psychiatry*. 2003; 60(7):727. [PubMed: 12860777]
- Wagenaar AC, Salois MJ, Komro KA. Effects of beverage alcohol price and tax levels on drinking: a meta-analysis of 1003 estimates from 112 studies. *Addiction*. 2009; 104(2):179–190. [PubMed: 19149811]

Figure 1.
Alcohol advertising by designated market area average for 2002–2009

Averaged by DMA

year	Advertising
2002	1.8859
2003	2.21334
2004	2.33673
2005	2.37948
2006	2.18832
2007	2.44003
2008	2.45302
2009	3.66399

Figure 2.
Averaged by designated market area

Figure 3.
Distribution of ln alcohol consumption for high advertising and low advertising designated market areas

Table I

Weighted means National Longitudinal Survey of Youth 1997

Variable	Definition	Mean	Standard deviation
In consumption	Natural log of drinks per month	2.68	1.33
In price	Natural log of weighted average real price of a liter of pure alcohol from wine and beer. Data were aggregated to the state level	\$3.45	0.06
Age	Age in years	23.78	2.61
Age squared	Age in years squared	572.40	123.93
Income	Real income in dollars divided by 100	\$96.75	92.96
Education	Years of education completed	13.60	2.46
Education * advertising	Education times In advertising interaction variable	32.49	17.13
Married	Dichotomous variable equal to one for individuals who are married	0.19	0.40
Male	Dichotomous variable equal to one for individuals who are male	0.53	0.50
Black	Dichotomous variable equal to one for individuals who are Black	0.11	0.32
Hispanic	Dichotomous variable equal to one for individuals who are Hispanic	0.12	0.33
Enrolled	Dichotomous variable equal to one for individuals who are currently in school	0.27	0.45
In advert	Natural log of total TV alcohol advertising on all channels in hours per day	2.40	1.20
2002	Year 2002	0.11	0.31
2003	Year 2003	0.11	0.31
2004	Year 2004	0.11	0.31
2005	Year 2005	0.12	0.33
2006	Year 2006	0.13	0.33
2007	Year 2007	0.14	0.35
2008	Year 2008	0.14	0.35
2009	Year 2009	0.14	0.35

Excludes nondrinkers $n = 24,443$.

Table II

Results quantile regression in consumption

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
In price	q10 -0.4972 (0.4540)	q20 -0.1540 (0.3928)	q30 -0.2277 (0.3542)	q40 -0.0364 (0.3354)	q50 -0.1800 (0.3279)	q60 -0.5037 (0.3364)	q70 -0.6261 ^{**} (0.3035)	q80 -0.4405 (0.3311)	q90 -0.6657 [*] (0.3823)
Age	0.3409 ^{***} (0.1094)	0.3489 ^{***} (0.0953)	0.3824 ^{***} (0.0902)	0.3138 ^{***} (0.0851)	0.3125 ^{***} (0.0814)	0.3099 ^{***} (0.0829)	0.2404 ^{***} (0.0791)	0.1400 (0.0885)	0.0270 (0.0940)
Age squared	-0.0065 ^{***} (0.0023)	-0.0070 ^{***} (0.0020)	-0.0076 ^{***} (0.0019)	-0.0061 ^{***} (0.0018)	-0.0061 ^{***} (0.0017)	-0.0062 ^{***} (0.0017)	-0.0047 ^{***} (0.0016)	-0.0029 (0.0018)	-0.0007 (0.0019)
Income	0.0013 ^{***} (0.0002)	0.0012 ^{***} (0.0002)	0.0010 ^{***} (0.0002)	0.0008 ^{***} (0.0001)	0.0007 ^{***} (0.0001)	0.0006 ^{***} (0.0001)	0.0004 ^{***} (0.0001)	0.0002 (0.0001)	-0.0001 (0.0002)
Education	-0.0083 (0.0077)	-0.0156 ^{**} (0.0066)	-0.0170 ^{***} (0.0060)	-0.0254 ^{***} (0.0052)	-0.0338 ^{***} (0.0050)	-0.0408 ^{***} (0.0053)	-0.0571 ^{***} (0.0049)	-0.0666 ^{***} (0.0050)	-0.0887 ^{***} (0.0069)
Married	-0.4897 ^{***} (0.0407)	-0.5570 ^{***} (0.0341)	-0.5642 ^{***} (0.0337)	-0.5741 ^{***} (0.0310)	-0.5692 ^{***} (0.0326)	-0.5301 ^{***} (0.0335)	-0.5208 ^{***} (0.0305)	-0.4542 ^{***} (0.0326)	-0.4200 ^{***} (0.0328)
Male	0.4578 ^{***} (0.0326)	0.5861 ^{***} (0.0281)	0.6445 ^{***} (0.0248)	0.6639 ^{***} (0.0235)	0.6782 ^{***} (0.0238)	0.6795 ^{***} (0.0233)	0.6659 ^{***} (0.0209)	0.6336 ^{***} (0.0239)	0.6295 ^{***} (0.0286)
Black	-0.4177 ^{***} (0.0447)	-0.5425 ^{***} (0.0361)	-0.5275 ^{***} (0.0336)	-0.5610 ^{***} (0.0325)	-0.5819 ^{***} (0.0307)	-0.5898 ^{***} (0.0312)	-0.5549 ^{***} (0.0314)	-0.4975 ^{***} (0.0336)	-0.3950 ^{***} (0.0421)
Hispanic	-0.1904 ^{***} (0.0490)	-0.1966 ^{***} (0.0399)	-0.1841 ^{***} (0.0369)	-0.1923 ^{***} (0.0325)	-0.1836 ^{***} (0.0309)	-0.1814 ^{***} (0.0330)	-0.1788 ^{***} (0.0317)	-0.1114 ^{***} (0.0331)	-0.0014 (0.0388)
Enrolled	-0.0438 (0.0376)	-0.0210 (0.0320)	-0.0132 (0.0282)	-0.0046 (0.0270)	-0.0093 (0.0266)	-0.0219 (0.0266)	-0.0338 (0.0255)	-0.0671 ^{***} (0.0299)	-0.0791 ^{**} (0.0328)
In advert	0.0327 ^{**} (0.0144)	0.0383 ^{***} (0.0126)	0.0498 ^{***} (0.0120)	0.0538 ^{***} (0.0106)	0.0658 ^{***} (0.0104)	0.0713 ^{***} (0.0105)	0.0813 ^{***} (0.0104)	0.0983 ^{***} (0.0107)	0.0888 ^{***} (0.0119)
Observations	24,443	24,443	24,443	24,443	24,443	24,443	24,443	24,443	24,443
DMA-FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

DMA, designated market area; FE, fixed effects.

Clustered standard errors at the state level are in parentheses.

 $p < 0.01$.**
 $p < 0.05$.*
 $p < 0.1$, bootstrap with 400 repetitions.

Table III

Results quantile regression in consumption

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
In price	q10 -0.9297*** (0.3455)	q20 -0.4496 (0.2951)	q30 -0.4767** (0.2357)	q40 -0.3678 (0.2411)	q50 -0.4253* (0.2366)	q60 -0.5206** (0.2198)	q70 -0.3364 (0.2158)	q80 -0.2682 (0.2203)	q90 -0.1606 (0.2877)
Age	0.2368* (0.1212)	0.4059*** (0.0998)	0.3743*** (0.0919)	0.3614*** (0.0929)	0.3274*** (0.0789)	0.2589*** (0.0852)	0.2202*** (0.0809)	0.1340 (0.0825)	0.0073 (0.0953)
Age squared	-0.0043* (0.0025)	-0.0081*** (0.0021)	-0.0074*** (0.0019)	-0.0072*** (0.0019)	-0.0065*** (0.0016)	-0.0052*** (0.0017)	-0.0044*** (0.0017)	-0.0028 (0.0017)	-0.0002 (0.0020)
Income	0.0015*** (0.0002)	0.0010*** (0.0002)	0.0010*** (0.0001)	0.0009*** (0.0001)	0.0007*** (0.0001)	0.0005*** (0.0001)	0.0003** (0.0001)	0.0001 (0.0001)	-0.0002 (0.0002)
Education	-0.0069 (0.0080)	-0.0191*** (0.0064)	-0.0185*** (0.0053)	-0.0274*** (0.0050)	-0.0380*** (0.0044)	-0.0426*** (0.0047)	-0.0548*** (0.0045)	-0.0666*** (0.0044)	-0.0868*** (0.0064)
Married	-0.5144*** (0.0475)	-0.5731*** (0.0374)	-0.5521*** (0.0302)	-0.5984*** (0.0298)	-0.5574*** (0.0305)	-0.5395*** (0.0301)	-0.5154*** (0.0316)	-0.4571*** (0.0298)	-0.4017*** (0.0362)
Male	0.4749*** (0.0374)	0.6161*** (0.0281)	0.6558*** (0.0252)	0.6541*** (0.0223)	0.6834*** (0.0221)	0.6911*** (0.0223)	0.6727*** (0.0208)	0.6415*** (0.0228)	0.6390*** (0.0274)
Black	-0.4680*** (0.0559)	-0.5540*** (0.0426)	-0.5343*** (0.0303)	-0.5944*** (0.0329)	-0.5818*** (0.0323)	-0.5926*** (0.0300)	-0.5503*** (0.0304)	-0.4975*** (0.0331)	-0.3752*** (0.0418)
Hispanic	-0.1780*** (0.0436)	-0.2025*** (0.0346)	-0.2027*** (0.0324)	-0.2189*** (0.0316)	-0.2193*** (0.0264)	-0.1850*** (0.0294)	-0.1451*** (0.0284)	-0.0927*** (0.0300)	-0.0029 (0.0326)
Enrolled	-0.0317 (0.0361)	-0.0205 (0.0287)	-0.0098 (0.0294)	0.0047 (0.0277)	-0.0105 (0.0272)	-0.0308 (0.0246)	-0.0416 (0.0274)	-0.0721*** (0.0242)	-0.0847** (0.0336)
In avert	0.0232 (0.0151)	0.0355*** (0.0131)	0.0483*** (0.0119)	0.0587*** (0.0109)	0.0669*** (0.0107)	0.0740*** (0.0102)	0.0850*** (0.0100)	0.0987*** (0.0107)	0.0840*** (0.0136)
Observations	24,443	24,443	24,443	24,443	24,443	24,443	24,443	24,443	24,443
DMA-FE	No	No	No	No	No	No	No	No	No
YEAR-FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

DMA, designated market area; FE, fixed effects.

Clustered standard errors at the state level are in parentheses.

 $p < 0.01$.**
 $p < 0.05$.*
 $p < 0.1$, bootstrap with 400 repetitions.

Table IV

Results quantile regression in consumption

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	q10	q20	q30	q40	q50	q60	q70	q80	q90
In price	-0.5024 (0.4819)	-0.1430 (0.3872)	-0.2219 (0.3588)	-0.0799 (0.3288)	-0.1865 (0.3223)	-0.5477* (0.3271)	-0.4763 (0.3143)	-0.3612 (0.3536)	-0.6864* (0.4085)
Age	0.3266*** (0.1133)	0.3452*** (0.0984)	0.3501*** (0.0881)	0.2815*** (0.0841)	0.2474*** (0.0787)	0.2364*** (0.0766)	0.1792** (0.0775)	0.0367 (0.0883)	-0.0864 (0.0929)
Age squared	-0.0062*** (0.0023)	-0.0069*** (0.0020)	-0.0069*** (0.0018)	-0.0055*** (0.0017)	-0.0048*** (0.0016)	-0.0047*** (0.0016)	-0.0036*** (0.0016)	-0.0009 (0.0018)	0.0014 (0.0019)
Income	0.0013*** (0.0002)	0.0011*** (0.0002)	0.0010*** (0.0001)	0.0008*** (0.0001)	0.0007*** (0.0001)	0.0006*** (0.0001)	0.0004*** (0.0001)	0.0002 (0.0001)	-0.0001 (0.0001)
Education	-0.0009 (0.0025)	-0.0044** (0.0023)	-0.0040* (0.0021)	-0.0066*** (0.0019)	-0.0092*** (0.0018)	-0.0120*** (0.0018)	-0.0169*** (0.0017)	-0.0188*** (0.0017)	-0.0253*** (0.0022)
In advert									
Married	-0.4904*** (0.0405)	-0.5535*** (0.0324)	-0.5536*** (0.0309)	-0.5700*** (0.0299)	-0.5622*** (0.0302)	-0.5339*** (0.0301)	-0.5244*** (0.0306)	-0.4586*** (0.0329)	-0.4091*** (0.0363)
Male	0.4597*** (0.0334)	0.5854*** (0.0286)	0.6431*** (0.0252)	0.6763*** (0.0243)	0.6807*** (0.0235)	0.6888*** (0.0225)	0.6699*** (0.0209)	0.6417*** (0.0252)	0.6610*** (0.0269)
Black	-0.4098*** (0.0485)	-0.5314*** (0.0366)	-0.5203*** (0.0347)	-0.5529*** (0.0339)	-0.5690*** (0.0325)	-0.5766*** (0.0333)	-0.5346*** (0.0324)	-0.4801*** (0.0327)	-0.3632*** (0.0429)
Hispanic	-0.1838*** (0.0448)	-0.2003*** (0.0400)	-0.1734*** (0.0366)	-0.1825*** (0.0335)	-0.1814*** (0.0324)	-0.1634*** (0.0344)	-0.1499*** (0.0342)	-0.0915** (0.0366)	0.0192 (0.0400)
Enrolled	-0.0478 (0.0389)	-0.0376 (0.0301)	-0.0221 (0.0283)	-0.0228 (0.0271)	-0.0362 (0.0251)	-0.0379 (0.0238)	-0.0715*** (0.0258)	-0.1186*** (0.0272)	-0.1220*** (0.0323)
In advert	0.0456 (0.0361)	0.0931*** (0.0297)	0.1039*** (0.0289)	0.1438*** (0.0261)	0.1892*** (0.0252)	0.2339*** (0.0265)	0.3157*** (0.0251)	0.3443*** (0.0248)	0.4265*** (0.0303)
Observations	24,443	24,443	24,443	24,443	24,443	24,443	24,443	24,443	24,443
DMA-FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
YEAR-FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Calculated advertising elasticity (ED = 13.6)	0.0333	0.0332	0.0495	0.0540	0.0641	0.0707	0.0859	0.0886	0.0824

Health Econ. Author manuscript; available in PMC 2016 July 01.

Clustered standard errors at the state level are in parentheses, bootstrap with 400 repetitions.

DMA, designated market area; FE, fixed effects.

 $p < 0.01$.**
 $p < 0.05$.*
 $p < 0.1$.