Effects of Alcohol Sales Restriction on DUI[1] related Convictions: A Case Study of Kentucky

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Abstract

This paper discusses the effect of restriction on alcohol sales on DUI related Convictions. The effectiveness of this restrictive policy has been widely debated in the economic policy literature; where the opponents view it as restriction on civil liberties while the proponents project it as a prerequisite to saving millions of life that are lost in alcohol related traffic accidents. The dependent variable is the count event, thus, Negative Binomial Model has been used for data analysis. The data on 120 counties of Kentucky has been used; showing the county status as being wet or dry, the area, population, licensed drivers, number of police officers and the DUI Conviction rates. Findings indicate that the dry counties have substantially lesser DUI Conviction rate as compared to the wet counties. Some of the control variables also have a significant impact but their influence is distinctly less than the dry/wet county status.

1. Introduction

This paper analyze the effect of alcohol availability on DUI (Driving Under the Influence of alcohol) related traffic offenses. The topic of alcohol consumption and its negative effects on the society appeared on national policy agenda at the turn of the nineteenth century; resulting in the 18th Amendment to the Constitution. Albeit its passage with high fanfare, the protectionist faced an uphill task to convince the voters that this prohibition is worthwhile and all the related costs of enforcement associated with this policy were considerably less than the benefits achieved from it. In case of a redistributive policy like this, where the customary distribution of costs and benefits are redefined; the burden of "proof" for the "success" of the new policy lies on the proponents. Hence this gigantic task of prohibiting a commodity in a society where there is an utmost emphasis on individual liberty, freedom and choice failed as the amendment was revoked after almost 13 years. Despite this setback, the prohibitionists kept the issue alive by persistently elaborating the negative effects of sale of alcohol on different aspects of the social life. One

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such area that is still a matter of considerable debate both in the professional ambit of practitioners and the academia is; the drinking and driving and the resulting traffic fatalities. This issue gained high level of interest during the second half of the twentieth century; when the "resistant prohibitionists maintained their right to prohibit the sale of alcohol in their communities via local option powers enabled by state legislatures" (Powers & Wilson, 2004). Hence, according to National Alcoholic Beverage Control Association (NABCA), out of more than 3,100 counties of the United States, there are in access of 500 that can be counted as dry counties. The efforts of the proponents of alcohol sales restriction were substantiated by the fact that "drinking and driving is the leading cause of motor vehicle accidents in the United States" (Jewell & Brown, 1995). The restrictive policies are not confined only to the sales of alcohol in a particular county; they ranged from increasing the price of the product to enhancing the punishment for the culprits. The conclusions of previous studies on the subject of consensual restriction on alcohol sale and its impact on reducing alcohol related issues varied a great deal. This was due to the varying approaches to the problem by the scholars and the diversity of factors that impact this issue. One of the most cited studies of Colon (1983) categorized states into wet and dry categories based on the existence of wet or dry county within that state. According to the findings of the study, there is a higher rate of traffic fatalities in those states which were categorized as dry as compared to those that were categorized as wet. The conclusion that he drew from these findings were that as the drivers who lives in dry counties have to drive a greater distance to buy and consume alcohol, thus they have a higher risk and hence "increased involvement in motor vehicle accidents" (Colon, 1983). The Colon (1983) study has been criticized because of his categorization of states. This is because he has overlooked the fact that in some cases very small percentage of population of the state lives in a county that is "officially" dry, thus, resulting in unrealistic estimates. In a similar study, Meier and Johnson (1990) studied various measures of alcohol restrictions in the 50 states. They also modeled the population inhibiting the dry areas and ranked each state according to the restrictiveness of its alcohol regulation. Although they found that "both of the variables were consistently negatively associated with night time traffic fatalities, but neither reached the 0.05 significance level" (Meier & Johnson, 2004).Contrary to the findings of the Colon (1983) Meier *et al.*(1990) and Chaloupka *et al.* (1993) finds that the dry counties have a negative impact on motor vehicle fatality rates if the impact of population is controlled. They "controlled for the pro- portion of the state s population residing in dry counties on motor vehicles fatality rates" (Chaloupka, Saffer, & Grossman, 1993). Another study by Winn *et al.* (1993) looked into the effects

of county level alcohol prohibition on Motor Vehicle accidents. Their finding showed "a significant decrease in the motor vehicle accidents in dry counties" (Winn & Giacopassi, 1993). However, they fail to take into account increased time and travel cost that resulted from the restriction on the sale of alcohol related products.

These contradictory findings from the studies conducted to look for answers to similar question (the impact and efficacy of restrictive policies regarding alcohol availability and its resultant benefits) was one of the reason that attracted me in doing this study; but this was not the only reason. One thing that are found common in most these studies the OLS regression has been used. However, as the data in most of these cases is count data, "the least squares analysis of event counts are very inefficient, have inconsistent standard errors, and many produce negative predictions for the number of events; least squares estimates with a logged dependent variable suffer from these problems and are biased and inconsistent as well" (King, 1989). Therefore the alternative as suggested by King (1989) is the event count models. Hence, the Negative Binomial Model is used for analysis that gives more efficient and consistent standard errors and also takes care of the issue of over dispersion that has a latent presence in this kind of study.

1.1 Theoretical Framework

The theoretical framework used for this paper is the situational crime prevention framework (Powers & Wilson, 2004). This framework is based on the rational choice model where the individual behavior and actions regarding unlawful activities is considered to be conditional upon the amount of risk associated with it. In addition to this, the perceptions of the people about the chances of getting caught and the severity of the punishment (cost) that they have to pay also determines whether they will going to take the risk or not. Thus, this framework focuses on three areas; namely 1) Increasing the effort, 2) Increasing the risk and 3) reducing the rewards (benefits). This framework implies that by increasing the perceived costs of an action and reducing the benefits obtained from it will result into diminishing marginal utility derived. The cost of drinking and driving can be increased by increasing the risk involved in being caught and also the amount of fine the culprit have to pay. In addition to the monetary penalties, the crime can be projected as an irresponsible behavior that can prove detrimental for the society at large. Similarly, the effort can be increased by prohibiting sales and consumption sights away from the high population concentration cities. These increase costs will automatically decreases the cumulative benefit that a person will obtain from

drinking with his/her family or may be in a bar by traveling to such long distances plus arranging either someone for bring him/her back home or to pay for a taxi. Furthermore, the perceived benefits will further diminish with increased patrolling by sheriffs and cops and more incidents of drunk drivers being caught while driving back home. Hence this will result in lesser risk taking by people to drink and drive and resultantly less accidents.

1.2 Hypothesis

Thus, based on the theoretical perspective used for this paper, the relation that is hypothesized based on the theory is that there will be less alcohol related traffic violations in a dry county than that of a wet one.

2 Data

The objective of this paper is to find out the effects of restricting alcohol sales on drunk-driving related traffic offenses. For this study, it has been assumed that by prohibiting alcohol sales in a county will drive the people of that county to drive larger distance which increases their cost related to travel, time and at high risk of being caught. Based on these assumptions, it has been hypothesized that there will be less drinking and driving incidents in those counties where sale of alcohol is prohibited as compared to those where the sale is allowed. The data used for this paper is a 1995 cross sectional data of 120 counties of Kentucky. The counties where the sale of alcohol is not permitted are categorized as dry counties; while those where there is permission of alcohol related products are labeled as wet counties. There are some counties in Kentucky where there is partial prohibition of sales i.e. a few cities in the county can sale alcohol related products but there is prohibition outside those cities. However, for this study the partial prohibition counties are also counted as Wet County. The reason for combining them with wet county is that these counties resembles quite closely with wet counties; also the cities where the alcohol sales is allowed is relatively at shorter distance from dry cities of that county. Hence, people don't have to travel large distance in this case. In total, there are 76 dry counties and 44 wet counties. The proxy used for measuring drunk-driving related traffic offences is the number of drunk-driving convictions. The effect of alcohol sales restriction has been measured by a dichotomous dependent variable that is dummy coded: Wet/Dry County, where Dry=1 and Wet=0.

There are quite a few other variables whose impact may also be significant on dependent variable. The effect of such variables is controlled by accommodating them in the model. These includes Number of Schools within

county with drivers education programs, number of municipal police (cops) in the county, number of County Sheriffs, number of non DUI convictions (includes convictions for reckless driving and speeding violations), number of licensed drivers in a county, the percentage of people between the ages of 18 and 24 residing within the county and the area of the county in square miles.

The inclusion of cops and Sheriffs is based on the assumption that more cops and sheriffs present in a county; better are the chances of capturing drunk-drivers and hence convicting them, resulting in the increased risk factor for the potential convicts. However, apprehending drunk- drivers is only one aspect of officer's multifaceted job. Therefore, the resources assigned specifically for monitoring and apprehension of drunk driving also determines the effectiveness of the effort. It is, therefore, important that the resources should be reflected into the model. The proxy used to represent those resources in our model is the number of non-DUI convictions; including convictions of reckless driving and speed violations.

In some of the previous studies, arrest rates have been calculated based on population. This may seem a better measure in those cases where the question asked is phrased in a way that is conditional upon the population in general. Here, the variable of interest is driving related offences; therefore only the part of population that is allowed to drive i.e. the number of licensed drivers in the county is used as control variable. Another control variable included in the model is the number of people between 18 and 24 residing within the county. The rationale behind using this as a control variable is the high correlation between people of this age group and the drunken driving convictions. In other words, the youngsters belonging to this age group are highly prone to drinking and driving offense and therefore there percentage in the population is also going to influence the dependent variable. Last but an equally important variable having its share of influence on the dependent variable is the area of the county. The assumption behind placing county area into the model is that it has a direct impact on drunken driving convictions rate: the larger the area of the county, the better are the chances of being caught. This is because the potential offender has to travel large distances; from place of consumption of alcohol to their places of residence.

Table 1 gives the summary statistics of the data; showing that in 120 counties of Kentucky, on average approximately 255 DUI related convictions occurred in a period of one year, ranging from a mere 7 in some counties to the alarming figure of 3507 in some high population density counties. Summary statistics of all the control variables are listed in the table.

Table 1: Definition of Variables and Summary Statistics, Kentucky Counties (N=120)

Variable Description	Mean	Standard Deviation	Min.	Max.
Dependent VariableNumber of Convictions for Driving While Intoxicated (DUI Conviction)	254.53	402.43	7	3507
Explanatory VariableWetdrymst 1=Dry county (No Alcohol Sale permitted in the County) 0=Wet County (Alcohol is allowed to be sold)	0.63	0.48	0	1
Control Variable Number of schools within county with drivers education programs (Schlswde)	3.71	4.67	0	25
Square Miles of the County (Sqmiles)	331.11	130.08	99	788
Number of Licensed Drivers with the county (Licensed)	22285.53	45610.92	1495	463295
Number of Municipal Police in the County (Cops)	38.87	102.26	0	918
Number of County Sheriff in the County (Sheriff)	20.13	78.13	2	853
Percent of total population between the ages of 18 and 24 in the county (Perc 1824)	0.10	0.02	0.07	0.23
Non DUI convictions by cops	90.17	306.88	0.43	2482.5
Non DUI convictions by sheriff	62.84	56.53	2.25	411

4 Results

The relationship between the variables understudy are given in the form of the following equation:

$$\text{DUI Convictions} = \beta_0 + \beta_1 \text{ wetdrymst} + \beta_2 \text{ Schlswde} + \beta_3 \text{ Sqmiles} + \beta_4 \text{ Licensed} + \beta_5 \text{ Cops} + \beta_6 \text{ Sheriffs} + \beta_7 \text{ Percs1824} + \varepsilon \quad (1)$$

The dependent variable is the number of DUI convictions in various Kentucky counties. The impact of the restrictive alcohol sales policy has been measured with the dichotomous variable labeled as wetdrymst. The effects of

those variables that can also be a reason for higher DUI convictions in a county are controlled by accommodating them into the model.

The model used for the purpose of analysis is the Negative Binomial Model. The reason for using this model is that the DUI Convictions is the count data. Table 2 presents the results obtained from the Negative Binomial regression. The value that has been considered to determine the appropriateness of the Negative Binomial Model for our data is the LRTest statistic for a=0. The value of this test statistic is significant: showing that a is significantly different from 0 and hence there is over dispersion in the data. This makes Negative Binomial Model appropriate to be used here as compared to the Poisson Model. This over dispersion can be explained by the fact that the DUI arrest (that is a prerequisite for DUI Conviction) is a function of time and other variables like area and the cops. This means that chances are that there will be more DUI arrests where the county area is large, there are more cops in the vicinity and the percentage of youngsters (between the age of 18 and 24) is relatively higher in the population.

The negative sign of the coefficient of the explanatory variable i.e. wetdrymst shows the inverse relationship with the dependent variable; with a very high significance. This can be interpreted as; the more a county is dry the lesser are the chances of DUI Convictions. The negative binomial regression results show that all the control variables but three are insignificant. The three whose effects are significant are sqmile, licensed and sheriff. Thus, the area of a county, the number of licensed driver in a county and the number of sheriffs in a county has significant effect on the number of DUI Convictions. All these results are according to the prediction of literature. The major unexpected result is that of the insignificance of the percentage of population between the age of 18 and 24 in the overall population.

The regression coefficients are not the only quantity of interest that we want to interpret from the Negative Binomial Model. The Marginal Change in the value of the dependent variable can also be calculated given a particular set of explanatory variables. In this case, the calculated value of Marginal change for wetdrymst dichotomous variable, keeping the rest of the variables at their mean, is -70.47. This can be interpreted as that being a Dry County decreases the offenses by approximately 70 DUI Convictions, holding all other variables at their means. Similarly, the Marginal Change for Sheriff is -3.02; keeping the rest of the variables at their mean. This can be interpreted as; the increase in the number of Sheriff will bring down the offences by 3.02 convictions.

Table 2: The Determinant of County-wise DUI Convictions in Kentucky Dependent Variable: County-wise DUI Convictions

Variable	Negative Binomial Model
Wetdrymst	- 0.37*** (0.11)
Schlswde	0.02 (0.01)
Sqmiles	0.00* (0.00)
Licensed	0.00*** (5.11e-06)
Cops	0.00 (0.00)
Sheriff	-0.02*** (0.00)
Perc 1824	2.92 (2.31)
NonDUIconvictionsbycops	-0.00 (0.00)
NonDUIconvictionsbysheriff	-0.00 (0.00)
Constant	4.40*** (0.27)
α	0.23** (0.03)
Log Likelihood	-654.53
Observations	112

*p < 0.10; **p < 0.05; ***p < 0.01 (two-tailed) Standard errors are given in parentheses

This can be explained from the perspective of the potential offenders. The presence of a Sheriff will increase the risk of being caught and will lessen the over benefit obtained by him/her from drinking and driving. Another quantity of interest that is used to analyze the effect of explanatory variables is the incidence rate ratio. This gives us both factor change and percent change. The factor change coefficient of wetdrymst is 0.69. This can be interpreted as the expected change from being wet to a dry county decreases the expected number of DUI Convictions by a factor of 0.69, holding all other variables constant. Similarly, the value of percent change coefficient of wetdrymst has been computed to be -31.25%. This can be interpreted as being a dry county decreases the expected number of DUI convictions by 31.25% holding all other variables constant. Another variable having a significant value for both factor change coefficient and also percent change coefficient is the number of licensed individuals in the county. The factor change coefficient of licensed has the value of 1.0. This can be interpreted as the increase in the number of driving license holder will increase the number of DUI Convictions by a fac-

tor of 1.0, holding all the other variables constant. Similarly, the percent change coefficient of licensed, having a value of number of 0%, can be interpreted as the increase in the number of licensed drivers in a county will not increase the DUI Convictions. Furthermore, the factor change coefficient and percent change coefficient of sqmiles are 1.0 and 0.1 respectively. The factor change coefficient tells us that an increase in the area of a county will increase the DUI Convictions by a factor of 1, holding all other variables constant. Similarly, the percent change coefficient tells us that by increasing the area of a county will increase the amount of DUI Conviction by 1%, holding other variables constant.

Lastly, the only variable left with a coefficient having significant value is the Sheriff. The factor change coefficient and percent change coefficient of Sheriff are 0.98 and -1.6 respectively. The interpretation of the factor change coefficient is that the increase in Sheriff will result in the decrease of DUI Convictions by a factor of 0.98. Similarly, the percent change coefficient shows that the increase in the number of Sheriff will decrease in the DUI Convictions by 1.6%.

Table 3: The Determinant of County-wise DUI Convictions in Kentucky (Odds Ratio Estimates) Dependent Variable: County-wise DUI Convictions

Variable	Negative Binomial Model
Wetdrymst	0.69*** (0.07)
Schlswde	1.02 (0.01)
Sqmiles	1.00* (0.00)
Licensed	1.00*** (5.11e-06)
Cops	1.00 (0.00)
Sheriff	0.98*** (0.00)
Perc 1824	18.52 (42.70)
Non DUI convictions by cops	1.00 (0.00)
NonDUI convictions by sheriff	1.00 (0.00)
α	0.23** (0.03)
Log Likelihood	-654.53
Observations	112

*p < 0.10; **p < 0.05; ***p < 0.01 (two-tailed) Standard errors are given in parentheses

From this analysis, it can be inferred that the effect of being a dry county has a significant effect on the event counts of DUI Convictions. Albeit some of the unexpected results, the overall results are in-accordance with the expectation. As expected, the effect of the area of a county on DUI Conviction is significant. The rationale for this effect is that the larger area implies more distance to travel and hence better chances of being caught. Similarly, the number of licensed people in the population also has a significant effect on the DUI Conviction; the reason being that it is highly probable that all those who are convicted of being Driving Under the Influence of Alcohol has drivers license. The result that is conspicuous is the insignificance of cops and significance of sheriffs. The reason for this could be that as cops operates in the municipal limits, while Sheriff operates generally on highways connecting different cities and counties, therefore, the chances of being caught increases while one is driving intercity rather than intra-city.

5. Summary and Conclusions

The paper addresses the question of whether being dry county effects the DUI Convictions rate. The data reveals that dry counties are significantly related to the count rates of DUI Convictions i.e. if a county is dry the DUI Convictions are less than the wet counties. This relationship has also been substantiated by the percent change, discrete change and factor change measures where the effect of Dry County been estimated by holding the rest of the variables at their mean. Furthermore this result has also been in accordance with the theoretical used for this paper. It is so because the more we increase the cost of a particular activity as compared to the benefits obtained, the rational decision making individuals will avoid going for that product.

In addition to wetdrymst, the regression reveals some other equally important variable that affect the DUI Conviction rate. These include area of the county, licensed people and number of sheriffs. Again all these variables are expected to be significantly influential because all of them suppose to increase the risk for the potential offenders and thus important decision making variable for them. However, there effect is much less as compared to the main explanatory variable i.e. the dry/wet dichotomous variable. It must, however, is necessary to acknowledge that adding more variable in the analysis will definitely improve the robustness of the results; as this is a very complex issue dependent upon a wide range of issues.

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