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Causality between Total Expenditures on Alcoholic Beverages and Violent Crime in USA*

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Abstract

This study examines the cointegration and causal relationship between alcohol expenditures and violent crime in the USA for the period 1960-2007 using Johansen and Juselius (1990) cointegration test and the Granger no-causality approach developed by Toda and Yamamoto (1995). The study does not find a long-run equilibrium relationship between total expenditures on alcoholic beverages and violent crime. The results of Toda and Yamamoto approach indicate that the total expenditures on alcoholic beverages do not Granger cause violent crime in the USA.

Keywords: Violent Crime, Alcohol Expenditures, Cointegration, Causality

1. Introduction

The alcohol-crime relationship has been the subject of considerable research and heatedly debated in the literature. This subject has attracted a great deal of attention amongst criminologists, biologists, sociologists, psychologists, policy makers and economists.

The World Health Organization (2007) estimates that less than one half of the adult population (about 2 billion people) consumes alcohol in the world. Alcohol consumption causes 2.5 million deaths (3.8% of total) and 69.4 million (4.5% of total) of Disability –Adjusted Life Years (DALYs) in the world.[1]

Abusive alcohol consumption can harm not only the drinker but also the society as a whole. Alcohol consumption is associated with over 60 health problems, injuries, deaths, traffic accidents, suicides, child abuses, absenteeism, vandalism, unemployment, divorces, and the crimes. Abusive alcohol consumption also entails high costs to the society. For instance, the economic costs of alcohol related violence are $46.8 billion per year in the USA (Waters, et al., 2004), and $42.7 billion per year in England and Wales (Dubourgh, Hamed, & Thorns, 2005).

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[1] http://www.who.int/substance_abuse/facts/alcohol/en/
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Evidences from surveys reveal that the use of alcohol is prevalent in many cases of criminal activities. Alcohol was a factor in between 19% and 37% of violent offenses from 1997 to 2008 in the USA (Rand et al., 2010). According to the National Crime Victimization Survey (NCVS) conducted in the USA in 2008 (Rand et al., 2010), 19% of victims of violent crime perceived the offender to be under the influence of alcohol. According to Survey of Inmates in State and Federal Correctional Facilities (SISFCF) conducted in the USA in 2004 (Rand et al. 2010), 37 percent of state prisoners report that alcohol was the factor in their violent offenses. According to British Crime Survey conducted between 2006 and 2007 (Nicholas, Kershaw, & Walker, 2007, p. 65), 46 per cent of violent crime victims reported that alcohol was involved when the crimes against them were commited.

Cross-sectional (Dukarm et al.,1996; Ferguson et al., 1996), longitudinal (Zhang, Wieczorek, & Welte, 1997; Fergusson & Horwood, 2000; Maldonado-Molina, Reingle, & Jennings, 2011; Popovici, Homer, & French, 2012), and time series data studies have indicated that an increase in alcohol consumption increases the probability that an individual engages in violent offenses. Ensor and Godfrey (1993) and Field (1990) who examined alcohol–crime nexus for England and Wales respectively, found that two variables are positively associated. Raphael and Winter-Ebmer (2001) investigated the impact of alcohol on violent offenses in a state level study in USA, and found that alcohol consumption is positively related to violent crime. Rossow (2001) examined the alcohol-homicide rate relationship for 14 European countries, and found that alcohol consumption is positively related to homicide rates in some of the countries. The findings also indicated that the correlation was the lowest in Southern Europe and the highest in the Nordic countries.

Saridakis (2004) employed an unrestricted vector autoregressive (VAR) model to determine the impact of socio-economic and demographic variables on violent offenses in the USA over the period of 1960-2000. He found causality between alcohol consumption and the serious offences of murder and rape in the USA. Bye (2007) who used autoregresive integrated moving average (ARIMA) model to examine the alcohol consumption and crime relationship in Norway for the period of 1911–2003, estimated that an increase in alcohol consumption of 1 litre per year increases violence rate by 8%.

The purpose of this study is to investigate the cointegration and causality between total expenditures on alcoholic beverages and violent crimes in the USA. It employs Johansen and Juselius (1990) cointegration test and the Granger no-causality approach developed by Toda and Yamamoto (1995). With the above in mind, the rest of the study is organized as follows. Section II discusses hypothesis regarding the relationships between alcohol consumption and crime. Section III describes data and the empirical methodology. Section IV presents empirical results. While Section V concludes the study.

2. The Links between Alcohol and Violent Crime

There is no simple theoretical model which adequately explains the relationship between alcohol consumption and criminal activity (Pernanen, 1991; Lispey, Wilson, Cohen, & Derzon,

1997; Bushman, 1997). Hayes (1993) divided the relationship into three major areas, such as causal, contributory and co-existence. Table1 illustrates a functional model explaning alcohol and crime nexus.

Table 1: A Functional Model Explaining the Alcohol Crime Nexus

Category	Example
Offences which specifically mention alcohol	1) Drinking and driving 2) Being incapable or disorderly in a public place having consumed alcohol 3) Being in contravention of occupational regulatory law e.g. railway staff
Offences against the Licensing Law	1) Serving under-age drinkers 2) Selling alcohol to under-age drinkers 3) Serving people who are already intoxicated
Offences committed while under the disinhibiting effects of alcohol where alcohol has affected the person's self-control or judgment	1) Where alcohol is used for 'dutch courage' e.g. a burglary
Offences resulting from an alcohol problem where alcohol need have not been consumed immediately prior to the offence being committed	1) To obtain money or goods where income has been spent on alcohol 2) Stealing alcohol to consume 3) Stealing goods to sell to buy alcohol
Offences where alcohol is used as an excuse	1) An account given in court to explain away criminal behavior

*Source:*Deehan, 1999: 4

There are five hypothesis about alcohol and violent criminal activity nexus in literature, namely, the direct-causal hypothesis, the common cause hypothesis, the conjunctive hypothesis, the conditional hypothesis, and the interactive hypothesis (Zimmerman & Benson, 2007, p. 446).

Under the direct-causal hypothesis, alcohol damages region of the brain that controls behavior and emotions. Alcohol impairs behavior, judgment, memory, concentration and coordination. It also leads to extreme mood swings and emotional outbursts. Therefore, it is a direct cause of violent crime. The common cause hypothesis claims that both alcohol consumption and criminal activity are linked by some other factors such as unemployment and short-sightedness. For example, if a person is unemployed for a long time, alcohol use can offer a means to escape problems of life (drinkers experiences mild euphoria), while at the same time, being unemployed may motivate violent offenses (since the opportunity cost of such acts is low). The conjunctive hypothesis asserts that the relationship between alcohol consumption and crime may be completely accidental. For example, the decision to engage in criminal activity may be made before consuming alcohol. According to the conditional hypothesis, existence (presence) of some intervening factors such as temporal lobe dysfunction, hypoglycemia, sleep deprivation and alcoholism can reinforce the effect of alcohol consumption on violent offenses. Finally, the interactive hypothesis states that the impact of alcohol consumption on violent offenses is mediated by some interceding factors such as overconfidence, risk taking and power concerns.

3. Data and Empirical Methodology

This study uses annual violent crime and total expenditures on alcoholic beverages data from 1960 to 2007 in the United States. Violent crime (offenses) includes murder and non negligent manslaughter, forcible rape, robery and aggravated assault. Both total expenditures on alcoholic beverages and recorded violent crime rates are proxy variables for alcohol consumption and total violent crime.

Violent crime rate and total expenditures on alcoholic beverages data are taken from the Bureau of Justice Statistics[2] and United States Department of Agriculture Economic Research Service[3] web sites respectively. All the series are transformed into natural logarithm scale prior to analysis.

To assess the causality between violent crime and total expenditures on alcoholic beverages, Toda and Yamamoto (1995) no-causality test is utilized. Toda and Yamamoto method is chosen due (as noted by Shirazi and Abdul Manap, 2005, p. 478) to following reasons: a) the standard Granger (1969) causality test for inferring leads and lags among integrated variables is likely to give spurious regression results and F-test becomes invalid unless the variables are cointegrated, b) the error correction model (Engle & Granger, 1987) and the VAR error correction model (Johansen & Juselius, 1990) as alternatives for testing of non causality between time series are cumbersome, c) Toda and Phillips (1993) claimed that the Granger causality tests in ECMs still contain the possibility of incorrect inference and suffer from nuisance parameter dependency asymptotically in some cases.

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[2] The violent crime rate can be obtained from
(http://bjs.ojp.usdoj.gov/dataonline/Search/Crime/State/RunCrimeStatebyState.cfm.)
[3] Total expenditures on alcoholic beverages data can be obtained from
(http://www.ers.usda.gov/resources/briefing/cpifoodexpenditures/Data/Expenditures_tables/table1)

Toda and Yamamoto (1995) procedure has an advantage in that it does not require whether the series are I(0), I(1), I(2) or whether the series are cointegrated (see Caporale and Pittis, 1999). Toda and Yamamoto (1995) procedure can be applied even when there is no integration or stability, and when rank conditions are not satisfied 'so long as the order of integration of the process does not exceed the true lag length of the model' (Toda and Yamamoto, 1995, p. 225). Unlike the conventional Granger causality test, the Toda and Yamamoto (1995) approach fits a standard vector auto-regression on levels of the variables not on the first difference of the variables.

Toda and Yamamoto approach requires estimation of an augmented VAR (k+d_{max}) model where k is the optimal lag length in the original VAR system, and d_{max} is the maximal order of integration of the variables in the VAR system. The Toda and Yamamoto Granger causality test employs a modified Wald (MWald) test for zero restrictions on the parameters of the original VAR (k) model. The coefficient of the last lagged d_{max} vectors is ignored in the VAR (k) model (see Caporale & Pittis, 1999; Rambaldi & Doran, 1996; Zapata & Rambaldi, 1997). MWald test has an asymptotic χ^2 distribution when the augmented VAR (k+d_{max}) is estimated. According to Rambaldi and Doran (1996), MWald tests for testing Granger no-causality increases efficiency when Seemingly Unrelated Regression (SUR) models are employed in the estimation. Toda and Yamamoto Granger no-causality test is employed in this study by estimating the following bi-variate VAR system using the SUR method.

$$\ln VCR_t = \alpha_0 + \sum_{i=1}^{k+d} \alpha_{1i} \ln VCR_{t-i} + \sum_{j=1}^{k+d} \alpha_{2j} \ln AEX_{t-j} + u_t$$

(1)

$$\ln AEX_t = \beta_0 + \sum_{i=1}^{k+d} \beta_{1i} \ln AEX_{t-i} + \sum_{j=1}^{k+d} \beta_{2j} \ln VCR_{t-j} + v_t$$

(2)

The optimal lag order is k, d is the maximal order of integration of the variables in the system (d_{max}) and u_t and v_t are error terms that are assumed to be white noise. Each variable is regressed on each other variable lagged from one (1) to the k+d_{max} lags in the SUR method, and the restriction that the lagged variables of interest are equal to zero is tested. From equation (1), "AEX does not Granger cause VCR" if $H_0 : \alpha_{2j} = 0$ against $H_1 : \alpha_{2j} \neq 0$, where $j \leq k$. Similarly, from equation (2), "VCR does not Granger cause AEX" if $H_0 : \beta_{2j} = 0$ against $H_1 : \beta_{2j} \neq 0$, where $j \leq k$.

4. Empirical Results

In the first stage of the empirical analysis, the Augmented Dickey-Fuller (ADF) unit root test is employed to test stationarity of the series. Results of unit root test are reported in Table 2. The results show that we can not reject the null hypothesis of unit roots for both variables in level forms. However, the null hypothesis is rejected when ADF unit root test is applied to the first differences of each variable. The first differences of the AEX and VCR are stationary indicating that these variables are integrated of order one, I (1).

Table 2: Unit root test for the variable under study using ADF test

Variables	Level	Critical value	First difference	Critical value	Integration Order I(d)
lnAEX	-1.746 (1)	-3.516	-3.738**(0)	-3.518	1
lnVCR	-1.885 (2)	-3.516	-4.684** (0)	-3.518	1

Notes: The numbers in parentheses indicates the selected lag order of the ADF model. Lags are chosen based on Akaike Information Criterion (AIC). ** indicate significance at   5% level. Mfit 4.0 was used for all computations.

The optimal lag length is important to identify the true dynamics of the model. To determine optimal lag length of VAR system, the sequential modified LR test statistic (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ) lag selection criteria are used. The result of selecting optimal lag length of VAR is reported in Table 3. LR, FPE, AIC, SC and HQ information criterion indicate that lag order of VAR (k) is 2, for bi-variate VAR.

Table 3: Lags under different criteria for bi-variate VAR model

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.034643	2.313088	2.394187	2.343163
1	413.4784	1.73e-06	-7.589934	-7.346636	-7.499707
2	14.18359*	1.45e-06*	-7.771798*	-7.366300*	-7.621420*
3	6.171843	1.47e-06	-7.756786	-7.189089	-7.546257

Notes:* indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each   test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

As Engle and Granger (1987) pointed out, only variables with the same order of integration could be tested for cointegration. Since AEX and VCR series are integrated with the same order I (1), Johansen and Juselius (1990) cointegration test can be employed.   Table 4 reports, Trace and λ-max tests to identify number of cointegrating vectors.

Table 4: Johansen - Juselius likelihood cointegration tests

Hypothesis	Alternative	Trace Statistics	Critical Value 5%	$\lambda - Max$ Statistics	Critical Value 5%
r=0	r=1	11.69633	15.49471	11.13347	14.26460
r ≤1	r=2	0.562866	3.841466	0.562866	3.841466

Notes: * indicate significance at 5% level and r denotes number of cointegrating vectors. EViews 5.0 was used for all   computations.

Table 4 provides, $\lambda - Trace$ and $\lambda - max$ statistics. The null hypothesis of no cointegration (r=0) against the alternative of r ≤1 is tested. Both tests indicate no cointegration between alcohol expenditures and violent crime. This result implies that there is no long-run equilibrium relationship between two variables.

Table 5: Toda and Yamamoto no-causality test bi-variate VAR model results

Null Hypothesis	Lag(k)	$k+d_{max}$	M Statistics	Wald p-values	Direction of Causality
AEX does not Granger Cause VCR	2	2+1=3	0.544	0.761	No Causality
VCR does not Granger Cause AEX			3.551	0.169	

Notes: The (k+d$_{max}$) denotes VAR order. The lag length selection was based on LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion. *** , ** and * denotes 1% and 5% , 10% significance level, respectively. EViews 5.0 was used for all computations.

Table 5 reports the optimal lag length (k), VAR order (k+d$_{max}$), MWald statistics, p values and direction of causality. Both the null hypothesis "Granger no–causality from AEX to VCR" and the null hypothesis "Granger no–causality from VCR to AEX" can not be rejected at the 5 percent level of significance. The test results suggest that there is no significant causality between

alcohol expenditures and violent crime rates and it does not support the assumption of a causal effect of alcohol consumption on violent crime over time in the USA.

The evidence reported here shows that alcohol consumption as a single factor does not cause an individual to engage in violent criminal activities. It also implies that some other factors such as sleep deprivation, alcoholism, psychological disorders, and physical conditions such as temporal lobe dysfunction may reinforce the effect of alcohol consumption on violent offenses.

5. Conclusion

This study has employed the Johansen and Juselius (1990) cointegration approach, and methodology of Granger no–causality test developed by Toda and Yamamoto (1995) to investigate long-run equilibrium relationship and the causality between total expenditures on alcoholic beverages and violent crime rate for the USA for the period 1960 - 2007. The results of cointegration test suggest that there is not a long - run equilibrium relationship between two variables. Toda and Yamamoto causality test based on bi-variate VAR model indicates no significant causality between total expenditures on alcoholic beverages and violent crime rate in the USA. The findings of this paper do not support the direct-causal hypothesis.

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