
Violence-related injury and the price of beer in England and Wales

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The paper examines the influence of the real price of beer on violence-related injuries across the economic regions in England and Wales. The data are monthly frequency of violent-injury collected from a stratified sample of 58 National Health Service Emergency Departments 1995–2000. An econometric model based on economic, socio-demographic and environmental factors was estimated using panel techniques. It is shown that the rate of violence-related injury is negatively related to the real price of beer, as well as economic, sporting and socio-demographic factors. The principal conclusion of the paper is that the regional distribution of the incidence of violent injury is related to the regional distribution of the price of beer. The major policy conclusion is that increased alcohol prices would result in substantially fewer violent injuries and reduced demand on trauma services.

I. Introduction

The association between alcohol consumption and violent behaviour is well documented and usually requires little elaboration. The association between the price of alcoholic drink and violence is less well known and does require some elaboration. Markowitz and others have extensively studied the link between the price of alcohol and violence for the USA.¹ While Markowitz (2000b) has examined the relationship between alcohol price and violence on an international basis using aggregate nationwide data, to our knowledge there have been no studies of this type specifically for England and Wales. This paper aims to fill this gap and at the same time highlight an alternative source of data on violence.

Crime Survey and police statistics are the standard sources for data on crime and victimization. However, these data under-represent violent crime – notably stranger and domestic violence.² Many offences are not reported to the police because for example, of fear of reprisals, because the identity of the assailant is not known and because there is reluctance on the part of the victim to have their own conduct scrutinized. With regard to crime surveys such as the National Crime Victimization Survey (NCVS) in the US and the British Crime Survey (BCS), reporting depends on the perception that a crime has been committed, and on the respondents recall.

An alternative source of data is the recording of violent injury by the Emergency Departments (EDs)

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¹ Cook and Moore (1993), Markowitz and Grossman (1998, 2000), Markowitz (2000a, b, c, d).

² The 1996 British Crime Survey included a computerized self-completion questionnaire designed to guarantee anonymity and measure the extent of domestic violence (Mirlees-Black, 1999). For further evidence see also Shepherd and Lises (1998).

Table 1. Information collected from all ED departments in the study

Type of information collected	Data format
Age	Years
Gender	Male/female
Date of ED attendance following assault	Date/month/year
Software package used for recording information	Name of package
Flow structure for patients through A&E department	Flow diagram

of regional hospitals. Importantly, these provide a measure of harm and are available at a community level – unlike national crime survey data. Data matching studies have found that police-recording of violence resulting in ED treatment varies with victim age, gender and violence location and cannot be predicted with any precision on the basis of injury severity.³ Monthly data on violent injuries from EDs in England and Wales were obtained for the purposes of this study but do not have the same detail and richness as the Home Office data. However, the availability of relatively high frequency data allows the analysis of violence-related injuries as an alternative measure of violent crime that incorporates, trend, seasonal and other systematic factors.⁴ In addition to the well-established association between alcohol consumption and violence, a number of studies have reported a negative relationship between alcohol consumption and the price of alcoholic drinks (for a survey of recent studies see Blake and Nied, 1997).

The purpose of this paper is to utilize ED data on violent-crime and develop an econometric model that explains violence-related injury across regions in England and Wales in terms of the real price of alcoholic beverages. The model will also examine the influence of regional socio-economic, demographic and environmental factors in explaining the trend in violence-related injury. The paper is organized in the following way. The next section examines the data on violence-related injuries and compares them with the Home Office data. Section III reviews the literature on alcohol and violence. Section IV describes the structural econometric model that links violence to the price of alcoholic drink and discusses the empirical results. Section V concludes.

II. Violence Statistics

The National Health Service (NHS) in England and Wales can be considered in terms of nine Health Regions in which are hospitals with one or more emergency department (ED). There are 226 major (24-hour emergency cover with on-site medical and nursing staff) EDs serving the nine health regions in England and Wales. Selection criteria for inclusion of EDs into the study were: (1) availability of computerized violence data for a five year period starting from May 1995 to April 2000 and, (2) agreement from the hospital ED director to be included in the study. A telephone enquiry revealed that 109 of the 226 EDs had retrievable computerized records for the period May 1995 to April 2000: the other EDs were not computerized or were in the process of being computerized. Fifty-one of the 109 ED clinical directors refused to participate in the study on grounds, usually, of lack of staffing in the department. This gave a sample size of 58 EDs.⁵ The information collected is shown in Table 1.

While hospital data has the advantage of having a relatively high frequency⁶ and can be classified by age and gender, it has the disadvantage of not, so far, identifying the associated type of violence, for example street violence, domestic violence or other circumstance.

We derive ten time series measures of violence, i.e. one for each *economic* region.⁷ Within each region⁸ and for each month, the total number of violent injuries, were summed across the hospitals within the specific region. It was necessary to weight each regional time series in order to allow for varying under-representation across regions, so that it was possible to compare figures across regions.

³ Shepherd *et al.* (1989), Sutherland *et al.* (2002). Similarly Kellerman *et al.* (2001) show that 13% of firearm injury cases did not appear in police record in Atlanta 1996–1998.

⁴ For a description and discussion of this new series see Sivarajasingham *et al.* (2003).

⁵ All 58 EDs were registered under the Data Protection Act and access to A&E computer systems was restricted to a limited number of departmental staff. Patient confidentiality was maintained at all times.

⁶ The data are recorded continuously but have been coded on a monthly basis for purposes of this study.

⁷ The economic and health classifications of regions in England and Wales differ slightly. The *health* regions of Trent and Northern & Yorkshire are divided into three *economic* regions: East Midlands, North East and Yorkshire-Humberside.

⁸ Henceforth, region denotes economic region and not health region.

Table 2. Violence-related injury rate in England and Wales

Gender and health region	Annual violence-related injury rate (%) by resident population
Males	0.75
Females	0.26
England and Wales	0.50
Eastern	0.28
South West	0.29
South East	0.31
London	0.40
Trent & Northern and Yorkshire	0.60
West Midlands	0.70
Wales	0.90
North West	1.00

Specifically, the weight for region i was obtained from the reciprocal of the coverage ratio for each region. The coverage ratio is the ratio of the sampled annual attendance at an ED within a particular region to the total annual attendance in the region. The data was obtained from the British Association for Accident and Emergency Medicine Directory (issue 1999).⁹ Hence, larger weights were given to regions with lower coverage ratios and vice versa.

Finally, by employing regional resident population figures, we were able to express the violence data as a percentage rate of the population. Table 2 presents the overall and regional distribution for the full sample, which suggests the existence of a north/south divide in the pattern of violence. In general, the Midlands, Wales and the North have a higher violence-related injury rate than the South including London.

III. Alcohol and Violence

Effects of alcohol on human aggression have been the focus of intense research interest whereas its effects on victimization have attracted interest only comparatively recently. A brief overview is given here, focusing on major meta-analyses and new insights from psychology, substance misuse, epidemiology and criminology. The literature includes very large numbers of studies of alcohol and violence, which utilize only simplistic aggregate data, which provide little reliable new knowledge (Shepherd, 1990).

Meta-analysis of 30 experimental studies of links between alcohol and human aggression utilizing both

quantitative and qualitative techniques concluded that alcohol does cause aggression although alcohol effects are moderated by methodological parameters (Bushman and Cooper, 1990). For alcohol versus control comparisons, effect sizes were smaller when the experimenter was blind to conditions and were larger when an aggressive response was required than when a non-aggressive alternative was available. For alcohol versus placebo comparisons, effects were smaller for blind studies and larger for studies in which the confederate was free to retaliate against the subject. It was also concluded that it was possible that drinking habits moderate alcohol effects. Taking up this theme, in the context of links between assault injury and alcohol consumption, a recent innovative case crossover study utilized usual alcohol consumption during the last 12 months as a control value (Borges *et al.*, 2004). In this study, the estimated relative risk of injury in the hour after alcohol consumption, as compared with no alcohol consumption during that time was 4.33 (CI, 3.55–5.27). Violence-related injuries were associated with higher relative risk, which also varied depending on the presence of alcohol dependence and usual frequency of drunkenness: those with alcohol dependence and high frequency of usual drunkenness had lower risks than those without alcohol dependence and with lower self-reported episodes of drunkenness in the last year. Similar findings resulted from analyses of blood alcohol content on ED admission. It was concluded that each episode of alcohol consumption results in an increase in short-term risk of injury, especially violence-related injury. Patients with the lowest usual involvement with alcohol were subject to a higher elevation in their risk immediately after alcohol consumption compared to those who drank more heavily.

The acute effects of alcohol on aggression are moderated by individual differences and contextual factors (Giancola *et al.*, 2003). Alcohol plays an important role in the intergenerational transmission of family violence (Giancola *et al.*, 2003). Violence typology has prompted research on problem drinking in the context of intimate partner violence (IPV) perpetration and victimization. With control, problem drinking has been found significantly to predict violence perpetration and violence victimization for both men and women (White and Chen, 2002). Partner drinking was not however related to perpetration or victimization for men whereas for women partner drinking was strongly related to perpetration and victimization and fully mediated the effects

⁹This data is very stable across the sample period and so the coverage ratio was time invariant. Therefore constant weights were utilized.

of problem drinking on perpetration but did not mediate these effects on violence victimization. It was concluded that the relationship between problem drinking and IPV was not spurious for men or women and that heavier drinking by partners put women at greater risk for perpetration and victimization and mediated the effects of their own problem drinking on perpetration (White and Chen, 2002). Consistent with this, a longitudinal study from the Pittsburgh Youth Study concluded that offences committed under the influence of alcohol were more prevalent among heavier alcohol users, more serious offenders, more impulsive youths, and youths with more deviant peers (White *et al.*, 2002). The same study concluded that there were no significant interaction effects of alcohol and drug use with impulsivity or deviant peers in predicting whether illegal acts were committed under the influence.

Another major longitudinal study, the Seattle Social Development Project (Hill *et al.*, 2000), provides evidence of four distinct trajectories of binge drinking during adolescence: early heavy binge drinking, increasing binge drinking, late onset binge drinking and non-binge drinking. Importantly, these different trajectories significantly predicted positive and negative outcomes in adulthood after controlling for demographic characteristics, early proxy-measures of the outcome and adolescent drug use. With regard to beverage type, longitudinal inter-relationships between specific beverages, physical symptoms and psychological distress have confirmed that the physical impairment – which is in large part responsible for the increased risk of victimization in violence (Shepherd, 1998) – operates similarly for beer, wine and spirits, for males and females and for adolescence of all ages (Hansell *et al.*, 1999).

Linkages between patterns of alcohol misuse and crime have been studied in the New Zealand Birth Cohort Study, taking into account confounding factors through the use of fixed effects regression methodology (Fergusson and Horwood 2000). Increasing alcohol abuse was associated with highly significant increases in rates of violent crime. Although control for observed and non-observed confounding through the use of fixed effects regression models indicated that much of this association was attributable to the effects of confounding factors associated with both alcohol misuse and crime, alcohol abuse remained significantly related to violent offending.

Markowitz (2000a) provides a recent survey of the implications of alcohol consumption and

violent crime. Her paper also provides the reasoning for the association between alcohol consumption and violent crime in terms of a utility maximizing framework. Alcohol consumption is commonly linked with spousal abuse (Gelles and Cornell, 1990; Leonard, 1993) and alcohol use and violence is strongly correlated (Kantor and Strauss, 1987). There are three favoured explanations as to why alcohol and violence is linked.

- (1) There exists a psychopharmacological relationship in which alcohol can alter behaviour by increasing excitability and/or boosting courage (Pernanen, 1981; Fagan, 1993). People are more likely to commit acts of violence when under the influence of alcohol than otherwise.
- (2) People use alcohol as an excuse for aberrant behaviour. Loss of inhibition and release of violent tendencies. Drunkenness gives people an excuse for violence (Fagan, 1990; Gelles and Cornell, 1990).
- (3) There are unknown common factors that result in both drinking and violent behaviour (Fagan, 1990), including personality variables, such as impulsivity and high risk taking.

However, there is no consensus on the link (Reiss and Roth, 1993). Markowitz (2000a) develops a model where violence is in the utility function but it is not a choice variable in the traditional sense. Violence is an expected or unexpected consequence of alcohol consumption. A person maximizes utility and chooses the level of alcohol consumption if violence is expected. If no violence is expected then the level of alcohol consumption is chosen without regard to the effect of violence on utility. Violence is produced by the chemical effects of alcohol consumption and by other factors that account for a person's propensity to violence – such as socio-economic or demographic elements.¹⁰ A violence production function relates violence to the price of alcohol, income and other variables.

Alcohol consumption relates to offending behaviour and only indirectly to injury through the behaviour of the offender to the victim. Studies that draw a link between alcohol consumption, drug abuse and violence are legion (for a recent survey see Raghianti, 1994). However numerous studies find the presence of alcohol in the victim as well (Gerson, 1978, Collins, 1982). It can then be argued that a high intensity of alcohol consumption increases the risk of victimization. In the sense of Markowitz (2000a),

¹⁰ A more complicated model allows for the effect of alcohol consumption on the expected cost of violence. In the case of spousal abuse alcohol consumption is used as an excuse for non-reporting and reduced expected penalty.

the intensity of alcohol consumption by the individual may be chosen without regard to violence on utility, but the objective probability of encountering violence increases.

While the evidence in the epidemiological and criminological literature for a causative link between alcohol consumption and violence remains questionable, some evidence of a causal link can be gleaned from the economics literature. Several studies from the economics literature have found a negative relationship between alcohol consumption and alcohol prices. Using the National Family Violence Survey in the USA, Markowitz and Grossman (1998, 2000) studied the effects of state excise beer taxes on child abuse. Markowitz (2000a, c) examined the effect of the price of alcohol on spousal abuse and physical assault by teenagers. In another study Markowitz (2000d), using aggregate international data, relates violence rates to alcohol prices. Cook and Moore (1993) conducted a time series analysis of the effects of alcohol prices on crime rates in the USA. In these studies the causation runs from the price of alcohol to alcohol consumption and from alcohol consumption to acts of violence resulting in violent injury.

IV. Estimation Methodology

In the following section we outline a theoretical framework for the econometric model of violent injury based on Markowitz (2000b). The likelihood of being a victim of violence (V_i) is assumed to be a function of the alcohol consumption of the victim (A_i) and that of other individuals (A_j) who could be acquaintances, strangers or perpetrators. Other factors are observed characteristics of the victims and perpetrators (X_i, X_j) that will be correlated with social, economic and environmental factors. On aggregation this gives rise to a violence determination equation of the form:

$$V_{nt} = v(A_{nt}, X_{nt}, u_{nt}) \quad (1)$$

where V_{nt} is the violence rate in region n at time t . A_{nt} is consumption of alcoholic drinks in region n at time t . X_{nt} is a vector of regional social and economic characteristics that correspond to the observed individual characteristics of both victim and perpetrator and u_{nt} is a stochastic component. The violence production function is augmented by a demand for alcoholic drink, which allows for the

possibility of violence being a determinant and therefore two-way causation.

$$A_{nt} = a(P_{nt}, Y_{nt}, V_{nt}, Z_{nt}, \varepsilon_{nt}) \quad (2)$$

Here P_{nt} is the real price of alcoholic drink in region n at time t , Y_{nt} is a measure of real income in region n at time t , Z_{nt} is a vector of other factors relating to the demand for alcohol and ε_{nt} is a stochastic term that captures unobserved characteristics.

Equation 1 can be thought of as a violence production function. The vector of variables that are contained in X include influences typically associated with violence such as measures of poverty, income inequality, ethnicity and economic and social deprivation. Equation 2 is an aggregate demand for alcohol. The principal determinants are the price of alcohol, real income and variables associated with alcohol consumption such as, sporting events, and seasonal measures. Equations 1 and 2 describe a simultaneous system that can potentially be estimated by two-stage-least squares. However, we do not observe the consumption of alcoholic drink by region,¹¹ but substituting Equation 2 into 1 a reduced form model described by (3) is obtained which shows the direct effect of changes in the price of alcohol on the incidence of violent injury.

$$V_{nt} = f(P_{nt}, Y_{nt}, \Omega_{nt}, \xi_{nt}) \quad (3)$$

where $\partial f/\partial P_{nt} < 0$, $\partial f/\partial Y_{nt} > 0$, Ω_{nt} is a vector of other influences $\{X_{nt}, Z_{nt}\}$ and ξ_{nt} is a composite error term. Equation 3 states that the price of alcohol has a negative influence on violent injury. A negative coefficient on the price of alcohol means that alcohol consumption causes violence, even if alcohol consumption is an endogenous variable and there is no obvious reason to believe that the price of alcohol is a determinant of violent injury. The direction of causation goes from alcohol prices to consumption of alcoholic drinks and from consumption of alcoholic drinks to violence. In this study, the dependent variable is the total monthly violent injury data weighted for unequal coverage across regions and expressed as a percentage of the regional population. In addition, seasonal dummies with Summer being the reference season, were used to capture any seasonal pattern in the data.

Table 3 presents some selected results using the real price of beer as a proxy for the price of alcohol. We present both fixed effects and random effects estimates.¹² The other independent variables used in the model include, the monthly regional youth unemployment rate, which acts as a proxy for youth

¹¹ Data on household nominal expenditure on alcoholic drink by region is available from the Family Expenditure Survey.

¹² The data rejected the pooled specification against the fixed-effects specification on a $F(9,582) = 36.2$.

Table 3. Dependent variable violence related injury rate (V_{it}); sample = 1995(5)–2000(04); cross-sections = 10; 600 observations; t -values in parenthesis

Variable	Fixed effects model	Random effects model
Autumn	−0.0438 (−6.74)**	−0.0435 (−6.64)**
Spring	−0.0194 (2.88)**	−0.0190 (−2.82)**
Winter	−0.0485 (−7.50)**	−0.0482 (−7.38)**
Sport	0.0359 (3.36)**	0.0359 (3.32)**
Real beer price	−1.310 (−4.44)**	−1.271 (−4.86)**
Real house price	−0.2274 (5.53)**	−0.2294 (−5.53)**
Youth unemployment	−0.0284 (−7.13)**	−0.0287 (−7.73)**
Ethnic density	0.0101 (2.51)*	0.0074 (2.13)*
Intercept	7.7281 (5.44)**	7.5723 (6.02)**
R -Sq. (within)	0.1966	0.1959

Notes: ** significant at the 1% level.

* significant at the 5% level.

real income, regional ethnic density, which is also positively correlated with other measures of economic deprivation, a dummy variable to capture major sporting events,¹³ and seasonal dummies. We use the monthly regional data on house prices as a proxy measure of regional wealth, which we suggest is inversely related to measures of poverty.¹⁴ An appendix discusses the data in detail.

Five clear results are obtained from the econometric analysis. First, the results show a strong negative relationship between the real price of beer and violent injury. Second, there is a negative relationship between real house prices and violence-related injury. The higher are real house prices in a region, we hypothesize, the lower is poverty and the lower is violence-related injury. Third, there is a strong negative relationship between youth unemployment and violence-related injury. The higher is unemployment, the lower is youth disposable income, and the lower the consumption of alcohol and consequently the lower the incidence of violent injury. Fourth, ethnic density is positively related to violence related injury. Fifth, there is a strong seasonal pattern to violence-related injuries with a significant reduction in violence-related injuries in the spring, autumn and winter months relative to summer and finally violent injury rises with the occurrence of major sporting events.

The larger time dimension of the data relative to the cross-section element raises concerns about serial correlation problems and the precision of

the estimated standard errors. To test for this, we re-estimate the equations of Table 3 with common first-order regression in the residuals. Table 4 shows the results are unaltered except for the significance of the measure of ethnicity in the case of random effects estimation.

The choice of fixed effects versus the random effects model is contentious in the biometric and econometric literature. While the fixed effects model can be costly in terms of degrees of freedom and the within variation in the data it allows for endogeneity of the regressors in that the individual effects are correlated with the regressors. However, the random effects model assumes that the individual effects are randomly distributed and are uncorrelated with the regressors but the estimates will be inconsistent if this assumption is false. The Hausman (1978) specification test has been used by applied researchers to distinguish between the two specifications.¹⁵ The specification test is a test for the orthogonality of the random effects and the regressors and is Chi-square with $K-1$ degrees of freedom. A Chi-square test with 8 degrees of freedom produced a value of 1.19, well within the critical value, indicating acceptance of the random effects specification.

The price of beer acts as a proxy for the price of alcohol in general. The potential for measurement error, which downward biases the estimate of the influence of the price of alcohol on violent injury, is dealt with by using instrumental variables.¹⁶

¹³ June 1996 Euro Cup, Oct–Nov 1999 World Rugby Cup = 1, zero otherwise.

¹⁴ Other criminological and socio-economic variables were experimented with but were rejected on grounds of statistical insignificance and multicollinearity. Variables included rate of police case clearance, proportion of police per regional population, income inequality, proportion of single parent families, proportion of recipients of Income Supplement and proportion of regional population of youth age.

¹⁵ See Baltagi (2001, chapter 4) for a full discussion.

¹⁶ The real price of beer is also a generated variable and falls foul of the Pagan (1984) critique of biased standard errors, which is also dealt with using instrumental variables. The additional instruments used are the TB rate, industrial production and bank and building society credit.

Table 4. Dependent variable violence related injury rate (V_{it}); estimated with AR(1) disturbances; 590 observations; t -values in parenthesis

Variable	Fixed effects model	Random effects model
Autumn	-0.0439 (-6.72)**	-0.0430 (-6.36)**
Spring	-0.0175 (2.56)*	-0.0182 (-2.64)**
Winter	-0.0485 (-7.45)**	-0.0476 (-7.05)**
Sport	0.0365 (3.40)**	0.0361 (3.22)**
Real beer price	-1.421 (-4.65)**	-1.189 (-5.28)**
Real house price	-0.2161 (5.17)**	-0.2342 (-5.45)**
Youth unemployment	-0.0277 (-6.87)**	-0.0286 (-8.08)**
Ethnic density	0.0104 (2.55)*	0.0047 (1.62)
Intercept	11.37 (8.19)**	7.228 (6.67)**
R-Sq (within)	0.1968	0.1934

Notes: ** significant at the 1% level.

* significant at the 5% level.

A Hausman specification test failed to reject the null of orthogonality between the regressors and the pure error term on a Chi-square of 8 degrees of freedom of 0.5. Table 5 presents the results of instrumental variables estimation.

The negative relationship between the real price of beer and violence was robust to the instrumental variables method of estimation. The estimated coefficient on the real price of beer is little different from that obtained from the fixed effects and random effects model, which confirms the result of the Hausman specification test that the regressors are exogenous. The estimated coefficients using the various methods of estimation show an impact of the log of real beer price on violent injury of -1.18 to -1.31 . This suggests that a 1% rise in the real price of alcoholic drink would reduce the economy-wide incidence of violent injury from an average of 0.5 to below 0.49, which amounts to a reduction of 5000 ED attendances for treatment following violence related injury.

V. Conclusions

We have examined the properties of violence-related injury data from NHS sources and developed an econometric model of the determination of violence-related injuries. The model was constructed from a general framework that incorporated socio-economic and environmental factors. There is strong evidence that the rate of violence-related injury is inversely related to economic activity and wealth measured either by real house prices (inverse of poverty) or unemployment (proxy for real income). A consistent finding was that the real price of beer exerted a negative influence on violence-related injury. Areas of high ethnic density are positively associated with

Table 5. Dependent variable violence related injury rate (V_{it}); sample = 1995(5)–2000(04); cross-sections = 10; 600 observations; t -values in parenthesis

Variable	Coefficient
Autumn	-0.0431 (-6.44)**
Spring	-0.0184 (-2.55)*
Winter	-0.0480 (-7.6)**
Sport	0.0357 (3.33)**
Real beer price	-1.182 (-2.56)**
Real house price	-0.2273 (-5.50)**
Youth unemployment	-0.0278 (-5.72)**
Ethnic density	0.0085 (2.32)*
Intercept	7.1375 (3.24)**
R-Sq. (within)	0.1961

Notes: ** significant at the 1% level.

* significant at the 5% level.

violence related injury. There is a clear seasonal pattern to the data showing that violence related injuries were higher in Summer. The study also shows that major sports events, which engage the national population, produce a significant increase in assault-related injury

Although the association between alcohol consumption and violence is well established, the causative route remains ambiguous. However, this study provides convincing evidence that violence-related harm is causally linked to alcohol price. The relationship between the price of beer (acting as a proxy for alcohol prices) is a novel finding. The data we have used represents an alternative source to official survey data and at the aggregate level conforms to conventional findings on violent crime. Further research will examine disaggregated data and focus on injuries to specific gender and age groups. Injuries to women and young children are also the result of domestic violence, which may require a separate analysis. While these data do not have

the richness of detail given in the BCS and RCS data sets, they have the advantages of availability at a community level and relative high frequency. It therefore provides an alternative data source for the analysis of trends and seasonality in violence. On the basis of this study, ED data provide an objective complementary measure of community violence and can be aggregated to measure regional and economy-wide violence related harm.

The study shows that a one percent rise in the real price of alcohol would equate to an economy wide reduction in ED assault cases of 5000 per year: a substantial reduction in harm and utilization of health resource.

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References

- Baltagi, B. H. (2001) *Econometric Analysis of Panel Data*, 2nd edn, John Wiley & Sons, Chichester.
- Blake, D. and Nied, A. (1997) The demand for alcohol in the United Kingdom, *Applied Economics*, **29**, 1655–72.
- Borges, G., Cherpitel, C. and Mittleman, M. (2004) Risk of injury after alcohol consumption: a case-crossover study in the emergency department, *Social Science and Medicine*, **58**, 1191–200.
- Bushman, B. J. and Cooper, H. M. (1990) Effects of alcohol on human aggression: an integrative research review, *Psychological Bulletin*, **107**, 341–54.
- Collins, J. (Ed.) (1982) *Drinking and Crime: Perspectives on the Relationships between Alcohol Consumption and Criminal Behaviour*, Tavistock, London.
- Cook, P. and Moore, M. J. (1993) Economic perspectives on reducing alcohol-related violence, in *Alcohol and Interpersonal Violence: Fostering Multidisciplinary Perspectives* (Ed.) S. E. Martin, National Institute on Alcohol Abuse and Alcoholism Research Monograph 24, NIH Publication 93-3469, Washington DC, pp. 193–211.
- Fagan, J. (1990) Intoxication and aggression, in *Drugs and Crime: Crime and Justice, a Review of Research*, Vol. 13 (Eds) M. Tonry and J. Q. Wilson, Chicago University Press, Chicago.
- Fagan, J. (1993) Interactions among drugs, alcohol and violence, *Health Affairs*, **12**, 65–79.
- Fergusson, D. M. and Horwood, L. J. (2000) Alcohol abuse and crime: a fixed-affects regression analysis, *Addiction*, **95**, 1525–36.
- Gelles, R. and Cornell, C. P. (1990) *Intimate Violence in Families*, Sage Publications Inc., Newbury Park, CA.
- Gerson, L. (1978) Alcohol related acts of violence: who was drinking and where the acts occurred, *Journal of Studies on Alcohol*, **39**, 1294–6.
- Giancola, P. R., White, H. R., Berman, M. E., McCloskey, M. S., Greer, T. F., Widom, C. S., Chermack, S. T., Leonard, K. E., Collins, R. L. and Quigley, B. M. (2003) Diverse research on alcohol and aggression in humans, *Alcoholism – Clinical and Experimental Research*, **27**, 198–208.
- Hansell, S., White, H. R. and Vali, F. M. (1999) Specific alcohol beverages and physical and mental health among adolescents, *Journal of Studies on Alcohol*, **60**, 209–18.
- Hausman, J. (1978) Specification tests in econometrics, *Econometrica*, **46**, 1251–71.
- Hill, K. G., White, H. R., Chung, I. J., Hawkins, J. D. and Catalano, R. F. (2000) Early adult outcomes of adolescent binge drinking: person and variable – centered analysis of binge drinking trajectories, *Alcoholism – Clinical and Experimental Research*, **24**, 892–901.
- Kantor, G. K. and Strauss, M. A. (1987) The drunken bum theory of wife beating, *Social Problems*, **34**, 213–321.
- Kellerman, A. C., Bartolomeous, K., Fuqua-Whitley, D., Sampson, T. R. and Parramore, C. S. (2001), *Annals of Emergency Medicine*, **14**, 204–8.
- Leonard, K. E. (1993) Drinking patterns and intoxication in marital violence: review, critique and future directions, in *Alcohol and Interpersonal Violence: Fostering Multidisciplinary Perspectives* (Ed.) S. E. Martin, National Institute of Alcohol Abuse and Alcoholism, Research Monograph 24, NIH Publication No. 93-3469, Washington, DC, pp. 193–211.
- Markowitz, S. (2000a) The price of alcohol, wife abuse, and husband abuse, *Southern Economic Journal*, **67**, 279–303.
- Markowitz, S. (2000b) Criminal violence and alcohol beverage control: evidence from an international study, NBER Working Paper 7481, January.
- Markowitz, S. (2000c) The role of alcohol and drug consumption in determining physical fights and weapon carrying by teenagers, NBER Working Paper 7500, January.
- Markowitz, S. (2000d) An economic analysis of alcohol, drugs, and violent crime in the National Crime Victimization Survey, NBER Working Paper 7982, October.
- Markowitz, S. and Grossman, M. (1998) Alcohol regulation and domestic violence towards children, *Contemporary Economic Policy*, **16**, 309–20.
- Markowitz, S. and Grossman, M. (2000) The effects of beer taxes on physical child abuse, *Journal of Health Economics*, **19**, 271–82.
- Mirlees-Black, C. (1999) Domestic violence: findings from a new British Crime Survey Self-Completion Questionnaire, Home Office Research Study 191, London, Home Office.
- Pagan, A. (1984) Econometric issues in the analysis of regressions with generated regressors, *International Economic Review*, **25**, 221–47.
- Pernanen, K. (1981) Theoretical aspects of the relationship between alcohol use and crime, in *Drinking and Crime: Perspectives on the Relationship between Alcohol Consumption and Criminal Behaviour* (Ed.) J. J. Collins Jr, The Guildford Press, New York.
- Ragghianti, M. (1994) A review of the links between drugs, alcohol and violence, Center for Substance Abuse and Research, *Mimeo*, University of Maryland, August.
- Reiss, A. J. and Roth, J. A. (1993) *Understanding and Preventing Violence*, National Academy Press, Washington, DC.

- Shepherd, J. (1998) Emergency room research on links between alcohol and violent injury, *Addiction*, **93**, 1261–63.
- Shepherd, J. P. (1990) Alcohol and violence, *Lancet*, **336**, 1223–4.
- Shepherd, J. and Lisle, C. (1998) Towards multi-agency violence prevention and victim support, *British Journal of Criminology*, **38**, 351–70.
- Shepherd, J., Shapland, M. and Scully, C. (1989) Recording by the police of violent offences; an accident and emergency department perspective, *Medicine Science Law*, **29**, 251–7.
- Sivarajasingham, V., Shepherd, J. P., Matthews, K. and Jones, S. (2003) Violence-related injury data in England and Wales: an alternative data source on violence, *British Journal of Criminology*, **43**, 223–7.
- Sutherland, I., Sivarajasingham, V. and Shepherd, J. P. (2002) Recording of community violence by medical and police services, *Injury Prevention*, **8**, 246–7.
- White, D. R. and Chen, P. H. (2002) Problem drinking and intimate partner violence, *Journal of Studies on Alcohol*, **63**, 205–14.
- White, H. R., Tice, P. C., Loeber, R. and Stouthamer-Loeber, M. (2002) Illegal acts committed by adolescents under the influence of alcohol and drugs, *Journal of Research in Crime and Delinquency*, **39**, 131–52.

of constructing monthly figures from an annual survey of a single month estimate is outlined for the case of beer prices.

The UK-wide price of beer (P) is a weighted average of the regional prices (P_i) over the n economic regions (11 including Scotland and Wales).

$$P = \sum_{i=1}^n w_i P_i$$

$$\sum_{i=1}^n w_i = 1$$

The CAMRA figures were regressed on the RPI beer prices (P^*) for March of each year data was available. If the true relationships are described by the following set of linear equations, where the ε s are stochastic error terms:

$$P = \alpha + \beta P^* + \varepsilon$$

$$P_i = \alpha_i + \beta_i P^* + \varepsilon_i$$

$$i = 1, 2, \dots, 11$$

The above set of equations can be estimated by a system with the following linear restrictions.

$$\sum_{i=1}^{11} w_i \alpha_i - \alpha = 0$$

$$\sum_{i=1}^{11} w_i \beta_i - \beta = 0$$

The estimated parameters of α_i and β_i are used to generate a monthly series of regional beer prices which will mimic the seasonal pattern of the ONS UK-wide data. Table A1 shows the estimates of the parameters comparing freely estimated ordinary least squares estimates with the restricted least squares estimates and Zellner Seemingly Unrelated Regression Estimates (SURE).

Data Appendix

Independent variables

Price of beer. Monthly figures for the price of beer is available from the Office for National Statistics (ONS) as input into the Retail Price Index (RPI). These are available on an UK-wide basis only. However, the Campaign for Real Ale (CAMRA) collects regional figures for beer. These figures are collected in March of the year, prior to the budget announcement. The figures are simple averages of beer prices per pint and include dates from 1989–2003 for beer for all the economic regions and the UK. The method

Table A1. Parameter estimates

Region	OLS			Restricted OLS			SURE		
	α	β	S.E.	α	β	S.E.	α	β	S.E.
North West	-9.05	0.8412	2.593	-7.22	0.8358	2.577	-7.59	0.8369	2.519
Yorks & Humber	-11.2	0.8878	3.100	-9.35	0.8823	3.028	-9.7	0.8833	2.980
East Midlands	-23.6	0.9890	3.294	-22.6	0.9859	3.108	-22.8	0.9864	3.094
North	-16.9	0.9588	3.572	-14.5	0.9518	3.523	-15	0.9533	3.447
Wales	-13.8	0.9323	3.903	-10.4	0.922	4.011	-11.2	0.9243	3.866
West Midlands	-25.9	0.9895	3.437	-23.9	0.9834	3.351	-24.3	0.9846	3.296
East Anglia	-13.6	1.026	3.912	-11.3	1.020	3.814	-11.8	1.021	3.747
South West	-18.7	1.033	2.846	-15.9	1.024	2.978	-16.5	1.026	2.856
South East	2.509	0.9659	5.422	5.512	0.954	5.422	5.681	0.9565	5.286
London	-1.44	0.9982	5.223	2.228	0.9872	5.19	1.432	0.9896	5.066
Scotland	-16.4	1.050	2.848	-15.2	1.046	2.715	-15.5	1.047	2.690

Table A1 shows the parameter estimates α_i and β_i and the standard error of the respective regression (S.E.).

The real price of beer and lager was obtained by deflating the derived regional series by the Retail Price Index excluding alcohol prices.

Regional house prices. Monthly estimates of regional house prices were obtained from the Nationwide Building Society website. The real price of housing was obtained by deflating the regional observations by the monthly UK Retail Price Index.

Youth unemployment rate. Monthly figures for youth unemployment rate was obtained from the Office for National Statistics

Proportion of regional population of ethnic origin. Annual data of the proportion of the population of ethnic origin by economic region was obtained from current and past issues of *Regional Trends*.

Sport dummy. 1 = June 1996, Euro Football Cup, Oct–Nov 1999, World Rugby Cup. Zero otherwise.