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England and Wales

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Violence, Gender and the Price of Beer in England and Wales

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**Abstract**

This paper examines the influence of the real price of beer on violence-related injuries split by gender across the economic regions in England and Wales. It was concluded that alcohol prices and injury sustained in violence is causally related in both males and females. Injury of females is causally related to poverty but injury of males. However, nationwide sports events were associated only with male assault injury. Violence-related harm was significantly and independently linked to other socio-economic and demographic factors. Our results suggest that the real price of alcohol (using beer as an example) has a part to play in controlling the consumption of alcohol and the incidence of violent injury.

**Key Terms:** Alcohol, gender, violence, price of beer.

**JEL Codes:** K40, I30, C50

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## **I. Introduction**

The link between alcohol and violence is one of the most researched areas in the epidemiological field. Most research has concentrated on the effects of heavy drinking or alcoholism and violent behaviour. Indeed the literature is replete with evidence of a strong correlation between alcohol consumption and violence (for recent surveys see Parnanen (1993), (1991) and Ragghianti (1994)). But even if the connection between alcohol consumption and violence is considered robust there is no consensus as to causation. The association can be viewed in three ways. First, alcohol misuse may cause violent behaviour. Second, people with a violent tendency may turn to alcohol as part of their antisocial behaviour. Or third, both alcoholism and violence share an unobserved common pathology.

A promising line of investigation has been pioneered by the work of Markowitz (2000a-c, 2001) who draws a link between the price of alcohol and violence. This line of reasoning cuts through the causation debate by arguing that since violence does not cause the price of alcohol, it follows that the relationship between the price of alcohol and violence must occur through the consumption of alcohol. A number of studies have examined this relationship in the case of the USA using survey data<sup>1</sup>, however, no study either in the USA or UK have examined this relationship using data obtained from Emergency Department (ED) sources.

The official data on violent crime in the United Kingdom are the British Crime Survey (BCS) and Police Recorded Crime Statistics (RCS). While the BCS provides a comprehensive snapshot of crime typology, its relative infrequency (roughly every two years and annually from 2001), means that statistical trends have to be analysed with a long-term view in mind. It is generally accepted that the BCS and Recorded

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<sup>1</sup> Markowitz (2001) also examines the relationship between international violence rates in terms of the differences in the price of alcohol.

Crime Statistics, both provided by the Home Office, under-record certain types of violent crime – notably stranger and domestic violence<sup>2</sup>.

This paper utilises violent injury data from EDs of regional hospitals in England and Wales. Monthly data on violent injuries from ED departments were obtained for the purposes of this study and represents the only objective data source of violence as it does not depend on the perception that a crime has been committed or on police reporting. The availability of relatively high frequency data affords the analysis of violence-related injuries as an alternative measure of violent crime that incorporates, trend, seasonal and other systematic factors.

The purpose of this paper is to show that there is a causal link between alcohol consumption and violent-injury using the price of alcohol as an instrument. We develop a structural econometric model that explains violence-related injury of males and female victims in terms of the real price of alcoholic beverages. The paper is organised in the following way. The next section reviews the literature on the link between alcohol consumption and violence. Section 3 outlines the analytical framework. Section 4 describes the data. Section 5 presents the empirical results. Section 6 concludes.

## **II. Alcohol and Violence**

According to the British Crime Survey 2000, victims of violent crime judged that in 40% of incidents, the perpetrator was under the influence of alcohol. Alcohol was mostly associated with ‘stranger violence’ (53%) – reflecting the high incidence of violent injury in or near pubs and night-clubs. Similarly in the USA, 40% of criminal offenders reported using alcohol at the time of the offence (Greenfeld, 1998). Indeed

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<sup>2</sup> The 1996 British Crime Survey included a computerised self-completion questionnaire designed to guarantee anonymity and measure the extent of domestic violence (Mirlees-Black 1999).

the association between alcohol consumption and violence is well documented in the epidemiological literature (Collins and Schlenger, 1988; Cook and Moore, 1993; Goldstein et. al., 1992; Martin, 1992; Murdoch et. al., 1991).

Links between alcohol consumption and injury in assault have been investigated by means of case-control studies, which have demonstrated a positive dose effect on seriousness of injury (Shepherd et. al, 1990a). Shepherd et al. (1990b) and Shepherd and Brickley (1996) discovered the links between injury and binge drinking of greater than 8 units of alcohol. Links between alcohol dependence and injury have been found only in victims aged over 35 years (Shepherd et. al., 1989). The mechanism for the link between 'binge' drinking and injury include physical handicap, poor decision-making, isolation in vulnerable settings and signals of immunity to prosecution (Shepherd, 1998).

There are a number of explanations why alcohol and violence are linked. One theory is that there is a psychopharmacological disinhibition process by which alcohol alters behaviour (Pernanen, 1976, 1991). By this explanation a provocative or threatening event can interact with a disinhibition process arising from the psychopharmacological effects of alcohol. Some explanations centre on the biological makeup of people (mostly men), which causes them to behave violently after alcohol intake (Linnoila et. al. 1989).

Another explanation is the 'deviance disavowal' theory whereby people use alcohol as an excuse for aberrant behaviour, loss of inhibition and release of violent tendencies. Drunkenness gives people an excuse for violence (Gil, 1970; Fagan, 1990; and Gelles and Cornell, 1990). Other types of explanations centre on the planned use of pharmacological effects. In this explanation, alcohol is consumed as a rational means of injecting a dose of 'Dutch courage' into a person (Burns, 1980; Pernanen,

1991). People are more likely to commit acts of violence when under the influence of alcohol than otherwise.

Finally, there may exist a common factor that results in both drinking and violent behaviour. It is argued that that the link between alcohol and violence arises because of risk factors and life styles that encourage alcohol consumption and independently increase the risk of involvement in violent activity<sup>3</sup>. Studies that have taken these common factors into account include Ensor and Godfrey (1993), White et. al. (1993), Fergusson et. al. (1996), and Fergusson and Horwood (2000). While these studies suggest a possible causal association, there remains no consensus as to the causal link (see Reiss and Roth, 1993).

However, some evidence of a causal link can be gleaned from the economics literature. Using the National Family Violence Survey in the USA, Markowitz and Grossman (1998, 2000) find a causative relationship between the variability of state excise beer taxes and the variability of child abuse. Markowitz (2000a, 2000c) found a causative link between the price of alcohol on spousal abuse and physical assault by teenagers. Cook and Moore (1993) conduct 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.

### **III. Alcohol, Violence and Saturday Night Fever**

In the following section we outline a choice model of behaviour that provides a theoretical framework for the link between the price of alcohol and violence. The demand for violence is derived from a utility maximising perpetrator, (see Markowitz

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<sup>3</sup> For example high alcohol consumption and violent behaviour has been associated with young people exposed to social disadvantage, dysfunctional families, and parental deviance.

2000a). The perpetrator's utility function given by (1) is maximised subject to the budget constraint (2).

$$U = U(A, V, X; \theta) \quad (1)$$

$$P_A A + \pi P_V V + X = Y \quad (2)$$

The arguments of the utility function consist of  $A$ , the consumption of alcohol,  $V$ , violent action on the part of the perpetrator,  $X$  which represents all other consumption goods and  $\theta$  which represents tastes and preferences<sup>4</sup>. The individual's budget constraint has real expenditure on alcohol ( $P_A$  is the price of alcohol deflated by the consumption goods price); the real cost of violence, where  $P_V$  is the real pecuniary cost of violence, whether it be judicial fines or loss of earning from a custodial sentence;  $\pi$  is the probability of prosecution for violent assault and  $Y$  is total real resources. So  $\pi P_V$  is the expected real cost of violence. The F.O.Cs are given by (3)-(5):

$$\frac{\partial U}{\partial A} - \lambda \left( P_A + \frac{\partial \pi}{\partial A} P_V V = 0 \right) \quad (3)$$

$$\frac{\partial U}{\partial V} - \lambda \pi P_V = 0 \quad (4)$$

$$\frac{\partial U}{\partial X} - \lambda = 0 \quad (5)$$

The key assumption of (3) is that the probability of prosecution for violent assault diminishes with intoxication, so that the perpetrator is charged on a lesser offence, or

the charges are withdrawn once the perpetrator 'sobers' up, or the victim fails to press charges ( $\partial\pi/\partial A < 0$ )<sup>5</sup>.

From (3)-(5) and (2), a violence demand function and an alcohol demand function for the perpetrator is obtained which, is described by (6) and (7).

$$V = V(\pi P_V, P_A, Y; \theta) \quad (6)$$

$$A = A(\pi P_V, P_A, Y; \theta) \quad (7)$$

Equations (6) and (7) have the following properties;

$$\frac{dV}{dP_A} = \frac{\partial V}{\partial \pi} \frac{\partial \pi}{\partial A} \left[ \frac{\partial A}{\partial P_A} \right] P_V + \left( \frac{\partial V}{\partial P_A} \right) \quad (8)$$

$$\frac{dA}{dP_A} = \frac{\partial A}{\partial \pi} \left\{ \frac{\partial \pi}{\partial A} \right\} P_V + \left( \frac{\partial A}{\partial P_A} \right) \quad (9)$$

The first term and the term in the square brackets of equation (8) is negative by the first law of demand. If the assumption  $\partial\pi/\partial A < 0$  is accepted, then the product of the first three terms is negative. The sign of the fourth term is positive or negative depending on if alcohol and violence are substitutes or complements. If they are substitutes, then there is an ambiguity to the sign of (8). Similarly, with equation (9), the first term is positive or negative depending on if alcohol and violence are substitutes or complements for the perpetrator. The term in the curly brackets is negative by assumption and the third term is negative by the law of demand. If it is assumed that violence and alcohol consumption are complements in the perpetrator's preference function, both (8) and (9) are negative.

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<sup>4</sup> See also Tauchen, Witte and Long (1991) for an examination of a model of domestic violence with violence as an argument in the perpetrator's utility function.

<sup>5</sup> Some evidence for the difficulty in prosecuting the perpetrators of alcohol related violence and perceived immunity from prosecution is in Shepherd (1998). It is also that in the case of domestic violence, where alcohol is involved, women are less likely to cooperate with prosecution., Barnish (2004).



Moving from the individual to the aggregate, we suggest that violence is determined by both the actions of the perpetrator and the victim. 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 ( $Z_i, Z_j$ ) that will be correlated with social, economic and environmental factors. On aggregation this gives rise to a violence determination equation of the form:

$$V_{nt} = v(A_{nt}, Z_{nt}, u_{nt}) \quad (10)$$

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  $t$ ,  $Z_{nt}$  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.

$$A_{nt} = a(P_{Ant}, Y_{nt}, V_{nt}, \Gamma_{nt}, \varepsilon_{nt}) \quad (11)$$

Here  $P_{Ant}$  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  $t$ ,  $\Gamma_{nt}$  is a vector of other factors relating to the demand for alcohol and  $\varepsilon_{nt}$  is a stochastic term that captures unobserved characteristics.

Equation (10) can be thought of as a violence production function. The vector of variables that are contained in  $Z$  include influences typically associated with violence such as measures of poverty, income inequality, ethnicity and economic and social deprivation. Equation (11) 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 (8) and (9) 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<sup>6</sup>, but substituting equation (11) into (10) a reduced form model described by (12) is obtained which shows the direct effect of changes in the price of alcohol on the incidence of violent injury.

$$V_{nt} = f(P_{Ant}, Y_{nt}, \Omega_{nt}, \xi_{nt}) \quad (12)$$

Where  $\partial f / \partial P_{Ant} < 0$ ,  $\partial f / \partial Y_{nt} > 0$ ,  $\Omega_{nt}$  is a vector of other influences  $\{X_{nt}, Z_{nt}\}$  and  $\xi_{nt}$  is a composite error term. Equation (12) 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.

#### IV. Data

The BCS data on crime provide useful micro-information, on crime in general, including violent crime, but it is an annual snapshot of criminal activity. However, seasonal and short-term trend patterns are difficult to infer from these conventional sources. An alternative source is hospital data on people injured by violence. This data is available at hospital level, and has been collected on a monthly basis from computerised records covering May 1995 to April 2000. There are 226 major A&E departments in England and Wales. Each department collects data (Contract

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<sup>6</sup> Data on household nominal expenditure on alcoholic drink by region is available from the Family

Minimum Data set) on patients. Additionally, departments that are computerised record whether an injury is caused by accident or by interpersonal violence. There were 109 A&E departments with computerised records of which 58 took part in the data collection exercise.

The raw data were collected on a monthly basis from May 1995 to April 2000 and disaggregated by age and gender, and were used to derive time series measures of violence for each *economic* region. In order to allow for varying under-representation across regions, the total number of persons injured by violence, were summed across the hospitals within the specific region and weighted by the ratio of the total hospital population in a region to the hospital population of the sample of hospitals in the data frame. Finally, by employing regional resident population figures, we were able to express the violence data as a per cent rate of the population. Table 1 shows the aggregate and regional break down of gender violent injury rates.

Table 1 shows a clear division between high violence-injury rates in the relatively depressed Northern and Western regions against the low rates in the relatively affluent South and Eastern regions. The ratio of female to male violent injury accords with the findings of the British Crime Survey. The total male violence-injury rate of 0.79% for England and Wales corresponds closely to estimates obtained from Kershaw et. al (2000), where total male victims of violence amounted to 5.3% in 1999 of which 14% required hospital treatment.

**Table 1**  
**Violent-Injury Rate Annual Average**

Region	Injury per 100 male population	Injury per 100 female population
East	0.387	0.134
East Midlands	0.585	0.226
London	0.573	0.222
North East	1.388	0.519
North West	1.357	0.465
South East	0.515	0.158
South West	0.406	0.141
Wales	1.318	0.460
West Midlands	1.060	0.374
Yorkshire-Humberside	0.837	0.338
England & Wales	0.791	0.283

**Figure 1**

**Violence Incidence Rate**

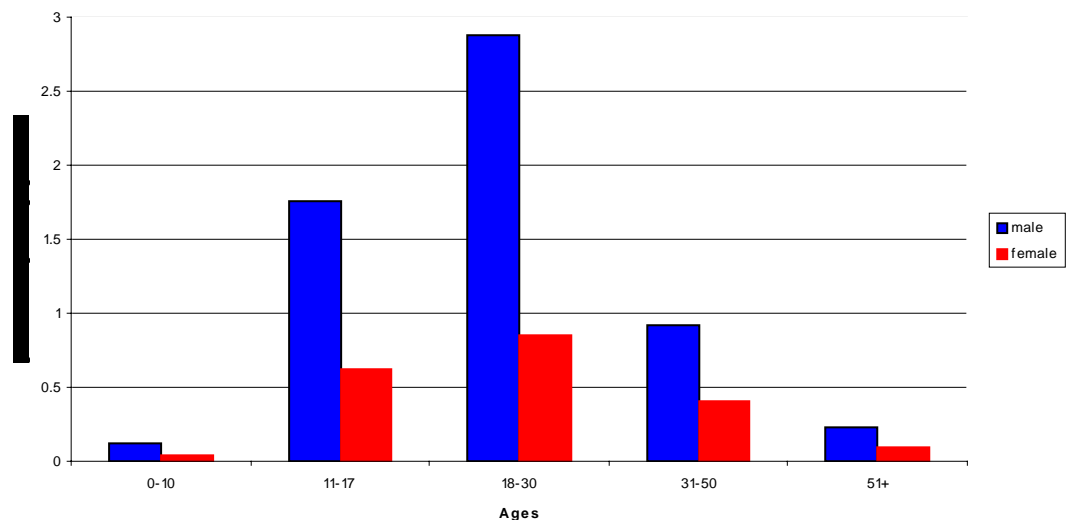


Figure 1 shows the incidence of violent injury by age group taken as the annual average for the full sample. The figures would be no surprise to the Criminologist. The highest incidence of violent injury is in the 18-30 age-group. The second highest is the 11-17 age group. On average, over 2 per cent of the 18-30 male population of England and Wales have reported to an A&E department in any given year as a victim of violent injury and 0.9 per cent of females. The figures for female

violent injury will also include victims of domestic violence<sup>7</sup> although the most common setting for female violent-injury is city-centre alcohol related incidents.

The dependent variable is the monthly violent injury rate separated into the male violent-injury rate and the violent-injury rate for females + children under the age of 11 (to allow for the possibility of children hurt domestic-violence related incidents). The vector of independent variables  $\{Z_n\}$  included a regional measure of household wealth (proxied by the average real house price) a direct measure of poverty and regional ethnic composition. The vector  $\{I_n\}$  included 3-month seasonal dummies, and a dummy variable for major sporting events.

There is no monthly measure of regional income but a good proxy is the monthly regional unemployment rate. We use the youth unemployment rate as a proxy measure of youth real income. While the link between unemployment and crime has been studied extensively, there has been little work on the link with violent crime. In a study using panel estimation with statistics covering the unified Germany, Entorf and Spengler (2000) found a positive relationship between young unemployed persons and assault. Even allowing for the effects of being young and unemployed, simply being young is more strongly associated with certain categories of crime, including rape and assault, which also suggests that a young population would be associated with higher levels of violent injury. However, unemployment has an ambiguous relationship with the incidence of violence. At the micro level, there may be some link between unemployment and violence but unemployment also acts as an inverse indirect measure of real income. High levels of youth unemployment also indicate low youth real income and consequently low demand for alcohol.

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<sup>7</sup> The age group most at risk from domestic violence is 16-24 and 32% of reported incidents were alcohol related (Mirrlees-Black, 1999).

The relationship between monthly real house prices and violence is a novel association and to our knowledge has not been identified previously. A common argument based on numerous sociological-type studies in the USA, is that measures of poverty and income inequality are good predictors of homicide and other violent crime<sup>8</sup>. We found no evidence of an association between measures of income inequality and violent injury<sup>9</sup>. However, we suggest that the socio-economic factors that lead to a higher incidence of violence are negatively related to wealth and other measures of economic well-being that enter the violence production function. The average real house price in a region is taken as an indicator of regional personal sector wealth and should be negatively related to violent injury. However, in the case of female and children under the age of 11, we find a direct measure of poverty helps the explanation independently of real house prices. The direct measure of poverty is the percentage of residents in households with disposable incomes in the bottom quintile.

A controversial finding is the over-representation of certain ethnic minorities in the crime statistics. Micro-data tends to confirm the positive association between ethnic minorities and crime. But this has also been confirmed by macro studies. For example Entorf and Spengler (2000) find that the proportion of foreigners in Germany has a positive relation to certain categories of crime. This variable may also be associated with other sociological type variables that have been associated with violence such as urbanisation and deprivation. We use the proportion of the regional population of ethnic origin as a measure ethnic density.

Measures of poverty have been associated with the incidence of domestic violence. The association between measures of income support and domestic violence have been researched by Tolman and Raphael (2000). Economic models of domestic

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<sup>8</sup> The most recent study being Kennedy et. al (1998).

violence emphasise the economic dependency of the victim on the perpetrator (Tauchen, Witte and Long 1991, and Farmer and Tiefenthaler, 1997) measured by the inequality income between the victim and perpetrator. As a proxy for poverty we use the proportion of residents in households with disposable incomes in the bottom quintile. Income inequality was taken as the ratio of male earnings in a specific region relative to female part-time earnings from the New Earnings Survey.

## **V. Econometric Issues**

The dependent variables are monthly violent-injury rates spanning May 1995 – April 2000 for 10 economic regions of England and Wales for males and females + children under the age of 11. The regional price of beer was obtained from the annual survey conducted by the Campaign for Real Ale. The data appendix describes how this data was transformed into monthly observations. Panel studies of crime have typically involved ‘fixed effects’ to account for cross-sectional heterogeneity<sup>10</sup>.

The preliminary stage of estimation indicated that pooled estimation was inappropriate. A conventional F test of ‘fixed effects’ against pooled (Table 2) and a Breuch-Pagan test of ‘random effects’ against pooled (Table 3) indicated support for a panel estimation technique. Table 2 shows the ‘fixed effects’ estimates for the male violence-injury rate and female (+ children under 11)-violence injury rate. Table 3 shows the same results for ‘random effects’. The F statistic in the last row of table 2 is the test for common intercept terms (pool the data) or fixed effects. The last row of table 2 is the Breuch-Pagan Lagrangian Multiplier test for random intercepts (random effects against pooled). In both cases (fixed effects and random effects) pooled estimation was strongly rejected.

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<sup>9</sup> Using New Earnings Survey data of the ratio of top ten percent earnings to bottom ten percent for each region.

The variables ‘Autumn’, ‘Spring’ and ‘Winter’ are 3-monthly seasonal dummy variables. ‘Sport’ is a dummy variable for the months of Euro cup 1996 and Rugby World Cup 2000. ‘Beer’ price’ is the log of monthly regional measures of a pint of beer deflated by the retail price index excluding alcohol price. ‘House price’ is the log of the Nationwide average regional house price deflated by the retail price index, ‘UnempY’ is the regional rate of youth unemployment, ‘Ethnic’ is the annual incidence of ethnic density by region and ‘Pov’ is the annual percentage of residents in households with disposable incomes in the bottom quintile.

**Table 2**  
**Fixed Effects; Sample = 1995(5)-2000(04); Cross-sections = 10; Intercepts not shown**

Variable	Male	Female (+children)
Autumn	-.0788***	-.0309***
Spring	-.0409***	-.0159***
Winter	-.0628***	-.0412***
Sport	0.0848***	-
Beer Price	-2.625***	-.4833**
House Price	-.3270***	-.1187***
UnempY	-.0414***	-.0147***
Ethnic	0.0121*	0.0096***
Pov	-	0.3885**
F(8,582)	11.81***	20.85***
F Common Int	463.2***	205.3***

\*\*\* significant at the 1%, \*\* significant at the 5%, \* significant at the 10%

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<sup>10</sup> See for example Entorf and Spengler (2000) and Machin and Meghir (2004).



**Table 3**  
**Random Effects; Sample = 1995(5)-2000(04); Cross-sections = 10; Intercepts not shown**

Variable	Male	Female (+children)
Autumn	-.0776***	-.0310***
Spring	-.0390***	-.0160***
Winter	-.0617***	-.0411***
Sport	0.0847***	-
Beer Price	-2.386***	-.6368**
House Price	-.3275***	-.1209***
UnempY	-.0400***	-.0162***
Ethnic	0.0091	0.0053***
Pov	-	0.4382**
Wald Chi Sq(8)	94.2***	16.0***
B-P LM Chi Sq(1)	8077***	6067***

\*\*\* significant at the 1%, \*\* significant at the 5%, \* significant at the 10%

Common effects for both male and female violence functions are the strong seasonal effects, which indicate that the summer months have a significantly higher incidence of violent-injury; real beer prices; real house prices and youth unemployment. The real price of beer has a stronger impact on the male violent-injury function than in the case of females. Youth unemployment, acting as a proxy for real income also has a stronger effect in the male violence function than in the female.

Factors that differentiated between the gender violence functions are, ethnicity; poverty and sporting events. Ethnicity was not significant in explaining male violent-injury (in the random effects model) but is strongly significant in the case of female violent-injury. Poverty is only significant in the case of female violent-injury, while nation-wide sporting events had a positive significant in the male violence function only. The results for the female violent-injury rate suggest that

while alcohol plays a significant role in explaining violence affecting women, other factors are also prevalent<sup>11</sup>.

The random effects model is consistent and efficient on the assumption that the regional specific effects are uncorrelated with the regressors. The fixed effects model is unbiased but inefficient if the regional specific effects are uncorrelated with the regressors. The Hausman (1978) specification test has been used by applied researchers to distinguish between the two specifications<sup>12</sup>. 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.

The Hausman specification test is Chi-square under the null of regressor effect independence. Rejection of the null hypothesis favours the fixed effects model.

Table 4 below shows the Hausman specification test fails to reject the null in the case of the male violence function indicating the random effects model in favour of the fixed effects model. However, the null is decisively rejected in favour of fixed effects in the case of the female violence function.

**Table 4**  
**Hausman Specification Test RE versus FE; P values in parenthesis**

<b>Statistic</b>	<b>Male Violence</b>	<b>Female Violence</b>
<b>Chi Square(8)</b>	0.39 (0.9999)	81.72 (0.0000)

While all the regressors are proxy or indirect measures of more appropriate variables, there are additional problems with the real price of beer and lager. First both variables are generated regressors, which produce biased standard errors (Pagan, 1984). Second, they are both imperfect measures of the price of all alcoholic drinks.

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<sup>11</sup> A number of other socio-economic variables associated with violence were used in the initial stage of estimation, such as male-female income differential, proportion of families on income supplement, proportion of single parent families, and measures of educational performance. They were excluded because of statistical insignificance.

The potential for errors-in-variables-bias and inefficiency is dealt with by the use of instrumental variable estimation.

Instrumental variable estimation will produce consistent estimates of the parameters. Table 5 presents the results for instrumental variables estimation<sup>13</sup> with random effects in the case of the male violence function and fixed effects in the case of the female violence function. A Hausman specification test, shown in the table supports the validity of the instruments.

**Table 5**  
**Instrumental variable estimation, sample = 1995(5)-2000(04); Cross-sections = 10; 'P' values in parenthesis, Intercept not shown**

Variable	Male	Female (+ children)
Autumn	-0.752***	-.0316***
Spring	-.0352***	-.0167***
Winter	-.0599***	-.0417***
Sport	0.0838***	-
Beer Price	-1.834**	-.6408**
House Price	-.3207***	-.1205***
UnempY	-.0354***	-.0161***
Ethnic	0.0106	0.0094***
Pov	-	0.3853**
Hausman Chi Sq(8)	0.44 (0.9999)	0.41 (0.9999)

\*\*\* significant at the 1%, significant at the 5%, \* significant at the 10%

Although unemployment and real house prices are indicators of regional economic activity, they both exert independent influences on the rate of violent-injury. Importantly, the coefficient on the real price of beer is negative and significant, with the effect on male violence being three times as much as that for females.

<sup>12</sup> See Baltagi (2001) chapter 4 for a full discussion.

<sup>13</sup> The instruments used are the monthly Treasury bill rate, monthly industrial production, and flow of monthly bank credit.

The results show that violent injury is higher in the summer months than in the other 3 seasons. Violent injury picks up during major sporting events, is negatively related to real house prices and negatively related to the youth unemployment rate. The latter variable is taken as an indirect measure of the inverse of youth real income. High unemployment indicates lower real income, lower demand for alcohol and lower violent injury.

## **V. Conclusion**

We have developed an econometric model of the determination of violence-related injuries of males and females (plus children aged less than 11). The model was constructed from a general framework that incorporated economic, socio-demographic and environmental factors. We conclude that the rate of violence-related injury is inversely related to wealth and regional economic conditions as measured by the real house price and regional youth unemployment.

We find that the real price of beer as a proxy for the price of alcoholic drinks exerts a negative influence on both the male and female violence injury rate. A rise in the real price of alcoholic drink would have a significant downward effect on the rate of violence-related injury.

We can confirm the existence of a seasonal pattern and a major sporting event influence on male violent-injury. The combination of seasonal, sporting and regional effects have implications for resource allocation across Accident and Emergency departments within the National Health Service in England and Wales.

## Data Appendix

### Independent Variables

*Price of beer and lager* –Monthly figures for the price of beer and lager (lower 80%) 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 of beer and lager prices. These figures are collected in March of the year, prior to the budget announcement. The figures are simple averages of beer and lager prices per pint and include dates from 1989-2003 for beer and 1993-2003 for lager for all the economic regions and the UK. The method 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  $\varepsilon$ 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  $\alpha_i$  and  $\beta_i$  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).

Table A1 shows the parameter estimates  $\alpha_i$  and  $\beta_i$  and the standard error of the respective regression (*S.E.*).

**Table A.1**  
**Parameter estimates**

Region	OLS			Restricted OLS			SURE		
	$\alpha$	$\beta$	S.E.	$\alpha$	$\beta$	S.E.	$\alpha$	$\beta$	S.E.
North West	-9.05	.8412	2.593	-7.22	.8358	2.577	-7.59	.8369	2.519
Yorks & Humber	-11.2	.8878	3.100	-9.35	.8823	3.028	-9.70	.8833	2.980
East Midlands	-23.6	.9890	3.294	-22.6	.9859	3.108	-22.8	.9864	3.094
North	-16.9	.9588	3.572	-14.5	.9518	3.523	-15.0	.9533	3.447
Wales	-13.8	.9323	3.903	-10.4	.9220	4.011	-11.2	.9243	3.866
West Midlands	-25.9	.9895	3.437	-23.9	.9834	3.351	-24.3	.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	.9659	5.422	5.512	.9540	5.422	5.681	.9565	5.286
London	-1.44	.9982	5.223	2.228	.9872	5.190	1.432	.9896	5.066
Scotland	-16.4	1.050	2.848	-15.2	1.046	2.715	-15.5	1.047	2.690

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.

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