

# Advertising and the misuse of alcohol

**Prepared by FDS International and Volterra Consulting**

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## EXECUTIVE SUMMARY

Binge drinking and its anti-social effects have become a matter of serious concern in the UK. There has clearly been a rapid rise in such behaviour over the past few years. While there have always been a very small minority of young people who have indulged in this sort of behaviour, it has become much more widespread. Anti-social behaviour arising through binge drinking is now a regular feature of the centres of what are normally regarded as 'respectable' towns.

Within this context, the Advertising Association (AA) has asked FDS International to produce three independent reports meeting the following aims:-

- a review of the evidence of the effectiveness of full and partial advertising bans on total consumption of alcohol and misuse of alcohol
- an update of the previous work by Mary Tuck (and later John Duffy) on the relationship between problem drinking and overall drink spend
- research to look at the role of social influences in the spread of binge drinking in the UK

FDS International brought in economic consultants, Volterra Consulting and together they scoped out a programme of work to meet these aims.

The key findings are as follows:

### 1. Review of the effectiveness of full and partial advertising bans

This review has to be seen within the context of the present debate as to whether exposure to alcohol advertising increases total alcohol consumption, particularly among young people, and whether there is a causal link between advertising and drinking. It concludes that the evidence on the impact of advertising on alcohol consumption is mixed and that there is a lack of conclusive evidence regarding a causal link. The evidence from the research on the impact of advertising bans on consumption is also inconclusive.

### 2. The relationship between alcohol abuse and consumption patterns

This report updates the work carried out by Mary Tuck in 1980 on the relationship between consumption and problem drinking, later updated by John Duffy in 1989, which challenged the belief held at that time that '*any increase in national consumption howsoever it may come about will result in more people with alcoholic problems*' and that controlling problem drinking lies in devising policies that control overall consumption. Our analyses show that there is a lack of consistency in the relationship between average alcohol consumption and the proportion of heavy drinkers by drink type – that is, there are differences in the relationship by sub-group. The importance of this result is that it suggests that a "one size fits all" policy to reduce overall consumption does not apply.

### 3. The importance of social network effects on problem drinking

This pilot study is ground breaking research into social networking effects on the misuse of alcohol. The results establish that social influence operating through personal friendship networks is *sufficient* by itself to explain a large rise in binge drinking amongst young people.

To put the conclusion beyond doubt, additional survey work and analysis is required to assess the *relative* importance of friendship networks and factors such as the price of alcohol. But, the findings show that behaviour of close friends is clearly a very important determinant of the rise of anti-social binge drinking in the UK and policy formulation needs to develop strategies that focus on this area. The authors believe that policies focusing on social influences will, with rigorous Government enforcement, bring success in this area in the same way that success has already been achieved in reducing the social acceptability of drink driving.

## FDS INTERNATIONAL AND VOLTERRA

FDS International was founded 33 years ago with a vision of building a company that would be known for the excellence of its work, and would grow through the loyalty of satisfied customers. Today, FDS and acefieldwork, combine together as one of the largest independent market research agencies in the UK, with a turnover of over £6 million. The company has grown both organically, and through strategic acquisition to enhance our expertise and complement the existing skills base. Over the years, clients are attracted by our unique combination of large company skills and resources, coupled with a level of service and attention to detail more often associated with smaller agencies.

Volterra is a boutique economics consultancy that specialises in the application of innovative and cutting-edge techniques to business problems. The team comprises mathematicians, statisticians, economists and physicists, who bring a unique multi-disciplinary approach to analysis. Founding directors, Bridget Rosewell and Paul Ormerod have extensive experience in economic forecasting and analysis.

## THE AUTHORS

The third report on social network effects was written by Paul Ormerod and Charlotte Cornish. Charlotte also had responsibility for co-ordinating the whole research programme.

**Paul Ormerod** read Economics at Cambridge University, and then took the MPhil in economics and econometrics at Oxford University. He worked as a conventional economic modeller and forecaster at the National Institute of Economic and Social Research in London from 1973-80. He left for the private sector to be Head of the Economic Assessment Unit at the Economist newspaper group.

Paul was a founding director of the Henley Centre for Forecasting – he helped build the Centre into a very successful commercial enterprise owned by the management team. In 1992 the Henley Centre sold to WPP Group Plc, a FTSE-100 company.

At the Henley Centre Paul pioneered the use of many quantitative techniques of analysis in marketing. He is the author of three best-selling books on economics for the general public, the Death of Economics, Butterfly Economics and Why Most Things Fail. Why Most Things Fail was named a Business Book of the Year 2006 by Business Week Magazine.

He is a leading expert on the analysis of social networks. He has recently been consulted on networks by the US Department of Energy, the government of Singapore, the United Nations Disarmament Commission, and the European Climate Change Science Council as well as commercial companies. He has published articles in top academic journals such as Physica A, Journal of Artificial Societies and Social Simulation and Diplomacy and Statecraft. He was elected a Fellow of the British Academy of Social Sciences in 2006.

**Charlotte Cornish** is Managing Director of FDS International. She is a highly experienced quantitative and qualitative researcher with a proven track record in building a business delivering high-end market research driven consultancy.

Following a classical market research training with leading agencies BMRB and Ipsos, Charlotte joined the Henley Centre (part of WPP), managing their flagship service “Planning for Social Change”. After gaining client-side experience with BT in the mid-90’s, Charlotte joined a new forecasting consultancy, the Future Foundation, as Research Director leading teams undertaking all quantitative and qualitative research. In addition, the role included the development of strategic forecasting consultancy services. Charlotte became Managing Director of Future Foundation Projects in 2004.

After leaving the Future Foundation in 2005, Charlotte advised the Pension Service (DWP) on the development of its strategy, liaising with stakeholders including the Secretary of State, Minister of State for Pensions and the DWP Permanent Secretary. Charlotte and her business partner Richard Hepburn purchased FDS International in June 2006 with private equity backing.

The literature review was conducted by FDS Research Associate - **Kate Melvin**. Originally a research and methodologist for Social and Community Planning Research (now the National Centre for Social Research) Kate Melvin has worked as a freelance research consultant for the last 13 years. Alongside working for FDS International, she is a Research Associate of Strategic Urban Futures.

The vast majority of the research and consultancy she has undertaken has been within the public policy arena and in particular health services research. Clients have included the General Medical Council (GMC), National Institute for Clinical Excellence (NICE), the Department of Health and Primary Care Trusts.

Kate has carried out extensive literature reviews including recently:-

- a review of the literature for NICE on breast cancer;
- for UNUM Ltd on the future of disability and the impact of disability legislation;
- an analysis of the literature on the provision of telephone help lines for the Commission for Health Improvement.

She is currently working with the National Centre for Social Marketing exploring and examining issues that will inform the development of social marketing interventions to effect changes in health behaviour.

Other past relevant work has included examination of under-age drinking market for the Portman Group.

The analysis and reporting in the second report were conducted by **Said Hirsh**. Said is a Senior Consultant at Volterra and an economist by training. He has been heavily involved in econometric and statistical modelling in a number of areas including macro- and micro-econometric modelling for financial services clients, and for commercial and residential property clients. He is also an expert in economic scenario generation and analysis. His recent projects include:-

- validation of Basel II IRB models for a financial services firm;
- using clustering and regression techniques to understand London's housing sub-markets;
- econometric testing to ensure validity of Economic Stress Test models;
- building econometric models to forecast rental values for commercial properties.

Said has acted as project manager in a number of complex assignments in the public and private sectors. He also regularly presents on the economy at clients' events and has recently presented at an international conference in Geneva.

Previously, Said spent four years carrying out research and teaching at the Universities of Bristol and Bath. He mainly taught statistics and quantitative methods for economists. He holds an MSc in Economics and Finance from Bristol University and a first degree in Economics. He also holds the Prince2™ Practitioner certification.

## Contents

### BACKGROUND

#### Report 1

#### Review of the literature on the impact of advertising on alcohol use with particular emphasis on the effectiveness of full and partial advertising bans

1	Introduction .....	1
2	Methods .....	1
3	General issues .....	3
4	Setting the context – impact of advertising on alcohol consumption – summary of the literature reviews .....	3
5	The impact of advertising bans .....	10
6	The wider context .....	16
7	Conclusion .....	18

#### APPENDICES

- A. Summary table of research into advertising bans
- B. Bibliography

#### Report 2

#### The relationship between alcohol abuse and consumption pattern

1.	Introduction .....	19
2.	Data .....	20
3.	Trends in National Average Consumption .....	22
4.	The Frequency of Consumption .....	24
5.	Consumption by Type of Drink .....	37
6.	Regional Variations .....	44
7.	Conclusion .....	46

#### APPENDICES

- A. Normality tests
- B. Regional charts

#### Report 3

#### The impact of drink advertising on problem drinking

1.	Introduction .....	47
2.	The data .....	48
3.	Characteristics of Binge Drinkers .....	50
4.	Social influences on binge drinkers .....	52
5.	Conclusion .....	57

#### APPENDICES

- A. Network modelling methodology
- B. ONS definitions and alcohol unit conversion

## **Report 1**

**Review of the literature on the impact of advertising on alcohol use with particular emphasis on the effectiveness of full and partial advertising bans**

## 1 Introduction

- 1.1 The purpose of this phase of the project was to review the literature on the impact of advertising on alcohol consumption that would include all material on the effectiveness of full and partial advertising bans.
- 1.2 However, it is important to set this review in context. There is a very broad and extensive international literature on the impact of advertising on alcohol consumption. In addition, there is already a body of work, that is discussed in greater detail below, which consists of reviews of this literature and more are forthcoming.
- 1.3 With this background, it was important that this review should not cover ground previously discussed but, instead, should mark out the parameters of the more general literature on the impact of advertising on alcohol use and, additionally, review in greater detail the literature on the effectiveness of full and partial advertising bans.
- 1.4 A further rationale for this approach was that alcohol advertising bans and restrictions are usually cited as one of the policy options open to legislative bodies and thus are of particular relevance to the present international and national debate.

## 2 Methods

- 2.1 The first step was to undertake a wide search process. A variety of databases, including PubMed, was used to source publically available research material. Search terms included:
  - (Advertising, voluntary advertising restrictions) and (consumption, consumption patterns, drinking habits, drinking level, underage drinking)
  - (Advertising bans)
  - 'Advertising as Topic' (MESH) AND 'Alcohol Drinking' (MESH) and 'Advertising as Topic' (MESH) AND alcohol'.
- 2.2 Abstracts of the reports and articles listed were perused and assessed as to their relevance. Once the papers and reports were obtained, their references were searched for further sources and, where relevant, were also sought out. Only two papers requested were not able to be obtained (Wilkinson, 1985, 1987). The literature obtained covered academic research, reviews of the literature, 'grey' literature, Fact Sheets and commercial research.
- 2.3 In addition, a number of individuals and organisations were also contacted and brief discussions were held. These included Institute of Alcohol Studies, Alcohol Concern, Ofcom, Joseph Rowntree Foundation, Professor Gerard Hastings and Dr Peter Anderson. The purpose of these discussion was firstly to ensure that no types of literature were being omitted and, secondly, to attempt to gauge an understanding of the wider context.

- 2.4 To assist the process of analysis, a proforma was developed to identify relevant information from each article. This included full citation, the nature of the article (whether based on research and, if so, the nature of the research), and full details of the article. The proformas were subsequently analysed.
- 2.5 At one level, it is relatively straightforward to categorise the literature sourced into reports of empirical studies and discussion papers that either review the research and/or discuss various policy options. In addition, there are international and national reports examining alcohol consumption that include aspects of the debate as to whether alcohol advertising impacts on consumption. However, the literature is compounded by a number of debates that surround many of the research findings, in particular whether or not alcohol advertising has a causal impact. Added to this, there is a growing body of literature emanating from public health specialists concerned with the abuse of alcohol especially among the youth. The following report attempts to cut across this picture by firstly reviewing reports and papers that review the more general literature on whether alcohol advertising impacts on alcohol consumption, highlighting specific studies were relevant, secondly, by reviewing the empirical literature on advertising bans and lastly by examining bans within a more general policy context. The final section looks at areas where the research presently appears to be more limited.
- 2.6 A full bibliography of all papers obtained is included at the end of this section of the report although not all of these proved relevant to this review. It should also be noted that the authors are fully aware that there is an extremely wide (and growing) body of literature on this topic and not all publications have been covered by this report.

### **3 General issues**

- 3.1 The influence of advertising and, indeed, marketing on alcohol consumption has been a subject of fierce debate for many years. Central to this debate are a number of key issues. Firstly, is the theory that increased consumption will lead to increased abuse and hence the cost to lives and health care costs. Secondly, whether alcohol advertising affects actual consumption as opposed to just brand purchase and thirdly, but of particular importance, is whether and to what extent alcohol advertising is a cause of initiation of drinking. These issues are, of course, particularly pertinent for drinking patterns among the young.
- 3.2 There are a number of different research methods that have been used to answer these questions. Firstly, econometric studies that use aggregated national or international data have examined the relationship between alcohol consumption, usually in terms of sales, and independent variables such as alcohol advertising, alcohol price, consumer income and other factors. Such studies have predominantly focused on time-series data or cross-sectional data. The second type of studies covers both qualitative and quantitative research and explores and examines how people in terms of their behaviour and attitudes are affected by their exposure to alcohol advertising. These types of studies tend to be either longitudinal, cross-sectional or panel data. The methodology of the research plays an important part in the debate as to the influence and impact of alcohol advertising.

### **4 Setting the context – impact of advertising on alcohol consumption – summary of the literature reviews**

- 4.1 There has been a number of literature reviews published that examine the research exploring the impact of advertising on alcohol consumption. This section outlines the more recent reviews on the basis that research has grown in the last ten to fifteen years, although the earlier reviews should also be noted (eg Smart, 1988, Fisher, 1993).
- 4.2 Econometric research that has examined the correlation of alcohol expenditure with overall alcohol consumption has been carried out in a number of different markets internationally with most reviewers referring to the following studies: In the UK (eg McGuinness, 1980, 1983, Duffy, 1989-2003), in Europe (eg Calfee and Scheraga, 1994) and the US and Canada (eg Lariviere, E, 2000, Nelson, 1999, Nelson and Moran, 1995, Lee and Trembley, 1992, Franke and Wilcox, 1987, Grabowski, 1976, Bourgeois and Barnes, 1979). This research has tended to show that alcohol advertising has little, if any, effect on aggregate alcohol consumption.

- 4.3 Duffy (1989), for example, explored why there had been, over the previous decades, marked differences in the growth rates of the consumption of beer, spirits and wine in the United Kingdom. Following his econometric analysis, he suggests that the expansion in consumption, particularly of spirits and wine, 'owes little, if anything at all, to advertising of these products'. In later studies, Duffy confirmed these findings and, more recently, based on UK data between 1963 and 1999, he found again that advertising appears to have no significant effects upon the demand for alcohol (Duffy, 2003). Lee and Tremblay (1992) looked at the US beer market between 1953 and 1983. Their empirical results showed that the price of beer and other drinks were particularly important in dictating demand but that advertising did not promote beer consumption. Similarly, Lariviere et al (2000), found that advertising was not effective in enlarging markets. They examined quantities consumed and expenditures on wine, spirits and beer in Ontario between 1979 and 1987. They also suggest that firms and especially breweries use advertising to compete in, 'zero-sum market share games'.
- 4.4 A recent comprehensive review of the econometric research is presented by Luik (2008). He draws attention to a number of studies that have examined the alcohol market internationally and concludes, 'Collectively, these (econometric) studies suggest that alcohol advertising does not increase total alcohol consumption, or has an impact that is so marginal as to be insignificant'.
- 4.5 However, he draws attention to the evidence that while advertising appeared to have an insignificant impact on the overall demand for alcohol, it did have an effect on individual product categories. Similar to other reviewers (eg ELSA report, 2005-2007<sup>1</sup>, Grube and Waiters, 2005), he discusses the work of Nelson and Moran (1995). They examined annual US data for the period 1964-1990 on beverage consumption, prices, expenditures and advertising and found there was little impact of advertising on the overall demand for alcohol but that there was an effect on individual drinks. For example, a decline in wine advertising resulted a greater demand for spirits. Hence, they suggest that alcohol advertising merely reallocates brand sales.
- 4.6 There is also evidence that the medium of advertising may have little effect on consumption. Using quarterly data between 1977 and 1994 on alcohol consumption and advertising, Nelson (1999) firstly found that alcohol advertising did not have a statistically significant effect on total alcohol consumption and, that secondly, the effect of broadcast advertising did not appear to be different to that of print advertising despite different rates of use.
- 4.7 In contrast to this, commentators (eg. Hastings et al 2005, ELSA report, 2005-2007) highlight the evidence from Saffer who has repeatedly shown a link between

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<sup>1</sup> In September 2007, a report on the Enforcement of national Laws and Self-regulation on advertising and marketing of Alcohol (the ELSA report), part-funded by the European Commission, was drafted and published by STAP, the National Foundation for Alcohol Prevention in the Netherlands. The ELSA report contains an overview by country of the laws and self-regulatory codes in place and assesses their adherence with the rules and recommendations on alcohol advertising contained in the Television Without Frontiers Directive as well as in the 2001 EU Council Recommendation on the drinking of alcohol by young people. The report also reviewed a selection of the scientific literature to address the link between commercial communications and young people's alcohol consumption. The methodology and the conclusions of the ELSA report have since been criticised in a report published by Landmark Europe in December 2007, at the request of the European Forum for Responsible Drinking.

advertising and consumption in a number of studies (Saffer, 1991-2006). In particular, using data from the National Longitudinal Survey of Youth 1997, he found that a 28% reduction in alcohol advertising would reduce adolescent monthly participation from 25% to between 24 and 21% and, for binge participation, the reduction would be from 12% to between 11% and 8% (Saffer and Dave, 2006).

4.8 Whilst acknowledging the overall conclusion of econometric studies that advertising does not affect total alcohol consumption, the majority of reviewers also stress a number of weaknesses in this type of research. In particular, such analyses use extremely sophisticated and complex statistical equations that are simply not able to explain many social phenomena (Hastings et al, 2005, ELSA report, 2005-2007, Anderson and Baumberg, 2007). These reviewers point to the following flaws:-

- data on key variables, most notably advertising expenditure, are missing
- advertising spending is assumed to be an accurate reflection of advertising effectiveness whereas content is also important (Strickland 1982)<sup>2</sup>
- models do not account for consumers' active involvement in the communication process (Casswell, 1995) and that alcohol advertising which centres on consumers' active involvement is more effective (Casswell and Zhang, 1998)
- complications such as feedback – the potential reciprocity of advertising and consumption levels – and advertising wear-out are frequently ignored
- beyond crude consumption levels, little insight is provided into consumers' drinking knowledge, attitudes and behaviour
- they focus on advertising and ignore the integrated nature of marketing
- Apart from the work by Saffer (eg Saffer 2006), econometric studies reveal nothing about the behaviour of sub-groups within the total alcohol market.

4.9 Saffer has argued (1996–2006), that using national aggregated data is unlikely to find an effect on consumption because of the 'advertising response function' that describes the relationship between alcohol advertising and alcohol consumption. The advertising response function is based on the theory of diminishing marginal product. According to this theory, the continued addition of advertising messages eventually will lead to smaller and smaller increments of consumption. Studies using national data on annual advertising expenditures (which vary little from year to year) measure advertising levels in a narrow range where advertising levels are high and the function is relatively flat. Hence these studies generally find that small changes in advertising levels have little effect on consumption. On the other hand, cross-sectional studies using local, short-term advertising data (which vary widely) measure advertising where the response function rises relatively steeply and are more like to find that increases in advertising raise consumption levels.

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<sup>2</sup> The author notes that the CAP and BCAP Codes regulate content in advertising

- 4.10 This analysis is disputed by Nelson and Young (2003), and Nelson (2005) who question the shape of the advertising response function on the basis that since promotion of alcoholic beverages takes place within a mature market, as most individuals are familiar with alcoholic beverages at an early age, diminishing marginal returns sets in immediately which is consistent with the empirical evidence for many mature markets. As such, it is an environment in which brand shares can change, but primary demand is stationary.
- 4.11 The majority of the research in this area shows that alcohol advertising has no or little effect on total alcohol consumption. As indicated above, however, such statistical analyses can only ever be an approximation and deal with total population samples.
- 4.12 Moving onto more consumer focussed research, there is an even greater debate between analysts and researchers. In terms of cross-sectional studies, both Luik (2008) and Hastings et al (2005) discuss a series of studies (eg Strickland, 1982, Grube and Wallack, 1994), Wyllie et al, 1998a, 1998b, Austin and Knaus, 2000, Aitken et al, 1988, 1989). Aitken et al (1988, 1989), for instance, conducted a cross-sectional survey of 433 ten to seventeen year olds in Glasgow. The findings showed that children were very aware of television alcohol advertising, in particular lager adverts, and suggested that under-age drinkers were more appreciative of alcohol advertisements and were more adept at recognising and identifying brand imagery than non-drinkers. Luik (2008) argues that while these studies might indicate that alcohol advertisements have a positive impact on attitudes to drinking, they are unable to prove a causal link between exposure and behaviour especially among adolescents. Indeed, it may well be a case of reverse causation i.e. those young people who are predisposed to drinking are more likely to watch and be attentive to alcohol advertising. Grube and Waiters (2005) also echo the view that the evidence from cross-sectional studies, on this basis, cannot be conclusive.
- 4.13 On the other side of the debate, Hastings et al, (2005) say that although these studies are not able to provide a causal link between advertising and the onset of drinking, they do suggest that the two are connected. Further, they note two studies by Wyllie et al, (Wyllie et al, 1998a, 1998b) who conducted cross sectional surveys with both 10-17 year olds and 18-29 year olds and measured how often they recalled having seen the advertisements and how much they liked them. The results provided 'tentative support for the hypothesis that positive responses to televised beer advertisements contributed to the quantity of alcohol consumed on drinking occasions'. More relevantly, they argue that the results did not support the hypothesis that the amount of alcohol consumed influenced the respondents' liking of the advertisements. Similarly, they refer to the work by Atkin et al (1984) who, in their survey of American teenagers, found that those who reported high levels of exposure but were not yet drinking, were more likely to do so in the future. Concluding that advertising and drinking were significantly associated they also suggested that this reflected advertising influence rather than reverse causation.

- 4.14 A more comprehensive analysis of cross-sectional studies is presented in the ELSA report (2005-2007).
- 4.15 Cross-sectional research studies, by their very nature, are unable to prove a causal effect, therefore, a number of reviewers have emphasised the importance of longitudinal research (Grube and Waiters, 2005, Hasting et al, 2005, Smith and Foxcroft, 2007). A longitudinal study is one that involves repeated observations with the same individuals over a period of time.
- 4.16 Smith and Foxcroft (2007) review seven of these studies – nine publications - in depth (Caswell et al, 1997, Caswell et al, 1998, Connolly et al, 1989, Ellickson et al, 2005, Snyder et al, 2006, Stacy et al, 2004, Robinson et al, 1998, van den Bulck and Beullens, 2005, Sargent, 2006). They conclude that the data suggests that exposure to alcohol advertising in young people influences their subsequent drinking behaviour and that the effect was consistent across the studies. The ELSA report 2005-2007 agrees with this analysis. However, Smith and Foxcroft also add a number of caveats including, for example, that the studies are unable to say how exposure brings about behaviour or what aspects of advertising and marketing are the active components. They also draw attention that in some of these studies, the level of attrition is unknown and that variables such as alcohol experiences, family history, peer influence and personality characteristics may act as confounding factors in the relationship between exposure to advertising and marketing and subsequent alcohol use.
- 4.17 Luik (2008), however, is critical of a number of these studies mentioned above on methodological grounds, sample design and in interpretation of the results. Snyder et al (2006) conducted telephone surveys with 1,872 young people aged 15-26 years in 24 media markets in four waves between April 1999 and February 2001. The authors found that youth who saw more alcohol advertisements drank more, youth in markets where there was greater alcohol expenditure drank more and that both the number of advertisements seen and advertising expenditures were positively associated with increased drinking over time. Whilst Luik states that this research provides a 'major support for the causal hypothesis about the effects of alcohol advertising, particularly on young people', he is critical of the work in a number of respects.

For example, in his view, there was a substantial attrition rate, there is sampling bias, both the advertising exposure data and drinking data are based on subjective as opposed to objective measures and a number of predictors of drinking (eg peer and parental drinking) are not taken into account.

- 4.18 More recent longitudinal research, however, has also suggested a link between advertising and subsequent drinking patterns. For example, Collins et al (2007), who surveyed 1,786 young people from South Dakota measuring exposure to television beer advertisements, alcohol advertisements in magazines, in-store beer displays and beer concessions, radio listening time and ownership of beer promotional items during 6<sup>th</sup> grade (approximately 11 years old) and drinking intentions and behaviour at 7<sup>th</sup> grade. They reported that those exposed to high levels of overall advertising exposure were subsequently 40% more likely to drink and 36% more likely to drink than those exposed to low levels. Concluding that the results support the hypothesis that exposure to alcohol advertising leads to underage drinking, they also argue that risks are posed to young people from other marketing sources as well as broadcast advertising. Similarly, Henriksen et al (2008) carried out a longitudinal study among American school children aged between 10-15 years and followed them up 12 months later. Analysis was carried out on those who were classified as 'never drinkers' (1,080) at baseline. They found that never drinkers who initially reported high receptivity to alcohol marketing were 77% more likely to initiate drinking at follow-up than those who were not receptive. However, the authors acknowledge that attrition was an issue (although this might mean the influence of receptivity is underestimated) and additionally there was no data collected on frequency of drinking or amount of alcohol drunk.
- 4.19 Of some note, too, is the publication in November 2007 of the second in a two-part research project jointly commissioned by the ASA (Advertising Standards Authority) and Ofcom examining the appeal of alcohol advertisements to under-18s. The report looks at the impact of alcohol advertising on young people following the tightening of the Advertising Codes in October 2005. The first research published in December 2005 established a benchmark against which the new rules could be assessed. The second part of the report published in November 2007 aimed to evaluate the impact of the tightened Codes and the changes to the alcohol market over the last two years. Extensive research was carried out by IPSOS MORI using qualitative and quantitative methodology samples representative of young people in the UK population. Ofcom and ASA deliberately set tough criteria for choosing which advertisements would be included in the research. This means that the research looked at the appeal of ads aimed at the younger end of the legitimate market, but whose appeal might also extend to those under the age of 18. The ASA noted that in 2007 finding such ads was more difficult, suggesting that the new codes have already had an effect on marketing techniques. Therefore, the advertisements chosen were not representative of all alcohol advertising but were a selection of alcohol advertisements, and these were described as from the edgier end of the market or may be considered 'borderline'.

The authors found that, following the code changes, although there was an increase in those saying that the advertisements make the drink look appealing and would encourage people to drink, there was no change in how much young people said they liked the adverts and there was a decline in the proportions of young people who said they felt the advertisements were aimed at them. However, the report also showed that children and young adults are being exposed to fewer alcohol advertisements on television and that there has been a significant decline in young people's recall of alcohol advertisements although a contributory factor to this may have been the decline in advertising spend.

4.20 Finally, given the complexity of factors that influence drinking behaviours, it is clear from the evidence that although the more consumer oriented, and specifically longitudinal, research is suggesting a link between advertising and consumption, further work is needed. Reviewers have called for longitudinal research to explore in greater depth the potential causal impact (Smith and Foxcroft, 2007) as well as studies that follow samples of young people from childhood to late adolescence that 'adequately control for past drinking behaviours and predisposition' (Grube and Waiters, 2005)<sup>3</sup>.

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<sup>3</sup> It should be noted that Anderson et al are presently completing a systematic review of longitudinal studies (Anderson et al, 2008, forthcoming)

## 5 The impact of advertising bans

- 5.1 In the available literature, advertising bans have been discussed in two main contexts. Firstly, as a means by which to examine the effect of alcohol advertising on consumption and alcohol related issues such as health and motor vehicle fatalities and, secondly, as a potential public policy for a solution to alcohol problems and/or as a regulatory mechanism alongside other possibilities. This section looks the empirical literature on advertising bans. Appendix 1 summarises 17 studies that look into the effect of alcohol regulations.<sup>4</sup>
- 5.2 Analysis of the effects of partial or full restrictions on alcohol advertising have been seen as a further way of assessing the extent to which advertising affects (or causes) alcohol consumption, if at all. Saffer (1991) regards it as an 'ideal empirical indicator of cumulative information about alcohol'. He bases this on the premise that continuous exposure to alcohol advertising over a long period could influence cumulative information about acceptable usage patterns and thus would affect total consumption. Whereas small variations in current advertising exposure are only able to have a limited influence on the individual's cumulative information about acceptable usage, banning alcohol advertising could indicate the extent to which consumption might be influenced by advertising.
- 5.3 One of the earliest studies of bans was Smart and Cutler (1976). Their study used monthly and yearly alcohol sales data from 1962-1972 in British Columbia where there had been a 14 month ban in 1971-1972. Ontario was used as a control. Both the yearly and monthly analyses of beer, wine and liquor consumption showed no substantial effect of the ban and they conclude that the data 'lent little support for the view that the British Columbia advertising ban reduced alcohol consumption'. However, the authors also note that the ban in British Columbia was not an ideal case study. In the first place, the ban was short and research focussing on an advertising ban in a single province or country must collect data over a long period before any change in consumption can be noted (Saffer, 1991, 1996). Other caveats to the research noted by the authors included the fact that the ban failed to gather public and mass media support, that national out-of-province advertisements could not be stopped and there was uncertainty about the retention of the ban with a change of government.
- 5.4 A second time-series study that had similar results was one carried out in Manitoba following restrictions of beer advertising in 1974. Ogborne and Smart (1980) used monthly beer sales data between 1970-1978 and found that beer consumption had not decreased since beer advertisements were withdrawn from the media. Beer sales in Manitoba were compared with those of Alberta where there was no ban, for the same time period and there was no significant difference between the two provinces.

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<sup>4</sup> Two further studies, (Wilkinson, 1985, 1987) ,were not available. The studies examined the relationships between alcohol consumption, advertising, and highway fatalities using a sample of 48 states for 1976-1979. Author concluded that the direct efforts of regulation on alcohol sales are relatively small ' (Nelson, 2001)

- 5.5 Calfee and Scheraga (1994) analysed the alcohol market of four European nations (France, Germany, UK and the Netherlands) between 1970 and 1991 and used Sweden as a control where a ban had been in operation since 1979. They concluded that there was no significant effect from advertising on consumption although they did find effects in terms of prices and income. Further, the regression results for the four countries without bans did not differ from that of Sweden and alcohol consumption declined in all five countries during the study period. Indeed, the authors concluded, 'social forces other than prices and income were bringing about a strong reduction in demand for alcoholic beverages and that advertising did nothing to ward off this trend towards reduced consumption'.
- 5.6 Ornstein and Hanssens (1985) used a cross-section of 50 states and the District of Columbia for the period 1974-1978. The years and the states were pooled together resulting in 255 observations for spirit consumption and 147 observations for beer. The results showed that control laws affecting price had the greatest impact on consumption but 'the influence of control measures is small relative to that of sociodemographic and economic variables that affect consumers' overall attitudes toward drinking'.
- 5.7 Another study found that the regulation of alcohol advertising had no effect on family violence towards children. Markowitz and Grossman (1998, 2000) carried out two cross sectional studies using a sample of 1,147 and 2,675 individuals with children living at home, taken from the National Family Violence Survey in 1976 and 1985 respectively. In the first study, they found that laws restricting advertising of beer were ineffective in reducing violence. When they pooled the data with the second sample, they found that increasing the sample size did not result in any change in the effect of the advertising on violence.
- 5.8 Dills et al (2004), on the other hand, used drunkenness arrests during Prohibition (1900-1925) in a sample of US cities as a proxy for alcohol consumption. Although some care has to be taken in interpretation of the results in that enforcement of drunkenness laws might have changed (either increasing or decreasing) during Prohibition, the results indicate that Prohibition had a substantial short term effect but almost a zero longer term effect on drunkenness arrests. The authors suggest that a national Prohibition had a limited effect on alcohol consumption.
- 5.9 A number of studies have found that even though advertising restrictions do not affect total consumption, they can have an effect on individual beverages. Makowsky and Whitehead (1991) analysed monthly data of alcohol sales between 1981-1987 in order to examine the effect of the lifting of the 58 year old advertising ban on alcoholic beverages in Saskatchewan in 1983. They found that alcohol advertising is not a contributory force influencing the overall level of alcohol consumption, the results also showed that the sales of beer increased and sales of spirits decreased following the regulatory change. There was additionally no impact on wine sales.
- 5.10 Similarly, Schweitzer et al (1983), in examining the relationship between consumption of beer and spirits using a cross-section of 35 US states for 1975, discovered that a prohibition on advertising does not lead to a reduction in alcohol consumption but to a shift from beer consumption to spirits consumption.

- 5.11 In contrast to the main body of work in this area, are a series of publications by Saffer (1991, 1997, Saffer and Dave 2002, Saffer and Dave, 2003). These stand out from other time series analyses, in that they find significant relationships in the data between advertising bans and alcohol consumption. The data set in the first study is a time series of cross sections consisting of 17 OECD (Organization for Economic Cooperation and Development) countries for the years 1970-1983. In his analysis, he found that countries with bans on spirits advertising have about 16% lower alcohol consumption and about 10% lower motor fatality rates than countries with no bans and that countries with bans on beer and wine advertising have about 11% lower alcohol consumption and about 23% lower motor fatality rates than countries with bans only on spirits advertising. Liver cirrhosis mortality rates were less consistently related to bans but were clearly related to alcohol price. Saffer comments that the disadvantage of using an international dataset is the difficulty of measuring other factors in alcohol consumption, eg cultural differences or 'sentiment'. On the other hand, given the fact that many years may be needed for a ban to make any noticeable change on consumption, there is unlikely to be enough empirical variation in one country to measure the effect of a ban.
- 5.12 Using the aggregated data set of 75 television markets (ADIs) that accounted for 75% of the population, Saffer (1997) carried out a cross-sectional analysis (1200 observations) to study the effects of advertising on motor vehicle fatalities. Finding a significant relationship, he estimated that a complete ban on broadcast alcohol advertising could save about 5,000 to 10,000 lives per year.
- 5.13 Extending the 1991 study, Saffer and Dave (2002), carried out a cross sectional study using a pooled time series of data from 20 OECD countries over the years 1970-1975. The results replicated the 1991 study finding again that advertising bans decrease alcohol consumption. There was also evidence that alcohol consumption had a positive effect on total advertising bans so that an increase in consumption could increase the likelihood of an advertising ban.
- 5.14 Finally, Saffer and Dave (2003) examined the effects of alcohol advertising on adolescent alcohol consumption (see Saffer and Dave 2006). Based on a data set from the National Longitudinal Survey of Youth 1997, the results suggest that a complete ban of all alcohol advertising could reduce adolescent monthly alcohol participation by about 24% and binge participation by about 42%. They also found that blacks participated less than whites.
- 5.15 Saffer's findings are supported also by a more recent research study by Hollingworth et al (2006). Estimating the effect of public health interventions to decrease harmful drinking among youth from literature reviews and estimating alcohol-attributable years of life lost by age 80 years among a cohort of approximately four million US residents aged 20 in 2000, the authors modelled the impact of interventions on alcohol-attributable mortality. They found that a tax increase and advertising ban were the most effective interventions identified. A complete ban on alcohol advertising would reduce deaths from harmful drinking by 7,609 and result in a 16.4% decrease in alcohol-related life-years lost and a partial ban would result in a 4% reduction. They conclude that advertising bans have the greatest potential for premature mortality reduction.

- 5.16 Saffer (1996, Saffer and Dave, 2003) supports these analyses by referring to the assumed shape of the advertising response function arguing that an advertising ban in certain media will shift the entire advertising function downward, reducing consumption. The degree of reduction will depend on the extent of the ban and the industry's reaction to it.
- 5.17 Young (1993) reanalysed Saffer's data (1991) of 17 OECD countries between the period 1970-1983 on the basis that there were, in his opinion, a number of flaws in the study. Firstly, there was evidence of reverse causation in that countries with low consumption rates and death rates tended to adopt advertising bans, which created a false negative correlation between bans and consumption and death rates. Bans may well exist in countries in which alcohol is less popular for various cultural reasons and so less alcohol is consumed but not as a result of advertising policy (as Saffer and Dave suggest in 2002). As well as controlling for cultural differences, this study also extended Saffer's study by examining the components of total alcoholic beverage consumption – spirits, beer and wine – separately. In addition, Young was critical of the methodological grounds of Saffer's statistical procedures in that he argues there was a 'high degree' of serial correlation. The findings of this study showed that when beverages are looked at separately, bans are associated with increased consumption as hypothesised below (5.25). For example, a ban on all alcohol advertisements was estimated to increase alcohol consumption by 0.6% and a ban on just spirits advertisements was estimated to increase consumption by 1.1%. However, a ban on all advertisements was associated with reduced motor vehicle fatalities but the magnitude of the estimated impact is only about one fourth of that found by Saffer.
- 5.18 In an extension to this study, Nelson and Young (2001) studied bans on 17 OECD countries this time for the years 1977-1995 in relation to per capita alcohol consumption, liver cirrhosis mortality and motor vehicle fatalities. The results showed that bans of broadcast advertising of spirits led to greater alcohol consumption and higher rates of motor vehicle fatalities. In addition, wider bans of additional media and beverages were not consistently related to alcohol consumption or abuse. They also found the unemployment rate and youth variables were especially important for motor vehicle fatalities and alcohol price was negatively related to alcohol consumption.
- 5.19 Hoadley et al, (1980) analysed the effect of state regulation and control measures on distilled spirits consumption between 1955 and 1980 at five yearly intervals for 48 US states. They argue that restrictions that were already in existence on the use of advertising had been almost ineffective as a deterrent to alcohol consumption. Similar to the studies noted above, they also found, however, that the presence of billboard restrictions was associated with higher consumption.
- 5.20 Nelson (2005) and Nelson and Young (2003), argue that a ban will not affect advertising consumption significantly based on the assumption that primary demand is stationary and that it is not clear at what point diminishing returns begin or the magnitude of this effect.

- 5.21 Both Saffer and Nelson, however, have drawn attention to the possibility that a ban in one media may well be substituted by an increase in advertising in other media (Nelson, 2001, Saffer, 1996, Saffer, 1998). Recently, Frank (2008) explored this issue by using a sample of liquor brands in the US over the years 1994-2004 to test the substitutability of advertising media. He argues that many of the advertising media used by liquor brands are highly substitutable and a partial media advertising ban would prove ineffective in reducing consumption. He also suggests that if the use of television advertising is prohibited, the findings suggest that liquor brands could maintain sales by increasing print advertising. He equally acknowledges that further research is needed to examine whether television is substitutable for print advertising among the young as well as among consumers as a whole.
- 5.22 Nelson (2003) used a longitudinal sample of 45 states for the period 1982-1997 to examine the importance of several restrictive alcohol control policies including state monopoly control of retail stores, advertising bans for billboards and spirit prices and changes in the minimum legal drinking age. Similar to earlier studies, he found that advertising bans do not reduce total alcohol consumption. However, relevantly, the study also examined substitution among beverages as a response to a law or regulation that targets one specific beverage. The results indicate that bans of billboard advertising increased consumption of wine and spirits and reduced the demand for beer. Although this study did not show that advertising restrictions are a convincing method for alcohol control, it did demonstrate the possible unintended consequences of restrictive regulations. Such substitution effects are also observed by other analysts (Hollingworth et al, 2006).
- 5.23 Nelson (2001) highlights a number of other reasons why advertising bans may not work. Similar to other commentators (Saffer, 1996, 1998, Atkin, 1993, Harrison and Godfrey, 1989) he argues that a ban on media can stimulate innovations within the set of non-banned media and other means of promotion. This is particularly pertinent in recent years with the growth in technology and the use of the internet. The Center for Media Education (quoted in Grube and Waiters, 2005) found that commercial alcohol web sites are easily accessible to youth and are often accessed from search engines through non-related key word searches for games, entertainment music etc. The ELSA report (2005-2007) stresses that information technology has given the industry a new promotional opportunity and comments that research has not yet covered an analysis of non-commercial websites that focus on alcohol products and drinking cultures.
- 5.24 A number of commentators have also called for further research that needs to look at how and to what extent the industry is making use of the new media technology such as mobile phone networks, cut price promotions, sponsorships etc as well as the internet (Cooke et al, 2002, Alcohol Concern Fact Sheet, 2004). In the USA, between 1983 and 1991 only 25% of total spending went to direct advertising while 76% went to other promotional activities such as sponsorships, product tie-ins etc (Jernigan 2001). Harrison and Godfrey (1989) also comment on the difficulty for individual countries to ban alcohol advertising with technological innovation and global pressures for deregulation. They go on to argue that new media such as broadband are extremely difficult to control in the absence of industrial self-restraint.

5.25 An additional reason Nelson believes that bans might not work is that he says that advertising can increase or decrease consumption. On the one hand he says that advertising may increase competition and result in lower prices and thus increase consumption. However, if advertising primarily affects brand and beverage shares with little or no effect on total consumption, then Nelson says it could increase product differentiation and/or signal product quality which could, in turn, result in higher prices and lower consumption. Nelson goes on to say that bans could therefore increase consumption because prices would be reduced. (Nelson, 2001, Nelson and Young 2001, Ambler, 1996). Makowsky and Whitehead (1991) also suggest that banning advertising could result in lower manufacturing costs, thus lowering prices and encouraging consumption.

## 6 The wider context

- 6.1 Examining advertising restrictions in a wider context, a number of commentators have drawn attention to other potential disadvantages to bans. Atkin (1993) suggests that elimination of broadcast advertising would produce only a small improvement in drinking problems and it might also be counter-productive for a number of reasons. Firstly, he says the quantity and placement of responsible drinking and drunk driving Public Service Announcements would be substantially diminished. He goes on to say public health and safety organisations would no longer be able to claim the need to balance pro-alcohol messages and a ban would eliminate those advertisements that might actually prevent consumption among certain groups by the nature of the content. For example, an advert that depicted male camaraderie may not appeal to women. Finally, the elimination of broadcast advertisements might be perceived as a 'solution' in itself and thus would divert attention away from other regulatory measures such as increased taxation, restricted availability etc. Harrison and Godfrey (1989) have contributed to his line of argument by commenting that whatever the advertising restriction, producers will attempt to mitigate the effects. Hence, restrictions on advertising may need to be accompanied by a tax policy to prevent price reductions which would probably increase consumption.
- 6.2 A further body of research has looked at the impact and effectiveness of a number of other strategies. For example, Agostinelli and Grube, (2002), reviewed the effectiveness of Public Service Announcements as well as product warning labels. They concluded that there was some evidence of the effectiveness of such strategies but the findings were mixed and qualified by the message, the source and audience factors. For example, for print and broadcast counter-advertisements (i.e., adverts that present a responsible drinking message), emotional appeal and the credibility of the source were influential factors in terms of their effectiveness and for warning labels, the content and design of the labels were important. In both cases audience factors too played a part in their effectiveness. Recently, Ringold, (2008) has examined and compared the role of alcoholic beverage advertising, media advocacy and industry sponsored responsibility advertising. The paper argues that evidence shows that industry-sponsored responsibility efforts appear to affect desired changes in behaviour and may be more effective than government messages with heavier drinkers. On the other hand, media advocacy is criticised on the basis that it takes away responsibility from the consumer and 'demonises particular industries'.
- 6.3 It has also been argued that there is a need for greater analysis on the cost-effectiveness of various strategies (Room et al, 2003). One such study, by Chisholm et al, carried out a cost effective analysis that looked at interventions such as physician advice, taxation, roadside random breath testing, restricted sales access and advertising bans. The analysis was carried out for 12 WHO sub regions. They reported that in populations with a high prevalence of heavy drinkers (more than 5% such as Europe and North America) the most effective and cost-effective intervention was taxation and in countries with a lower prevalence of heavy drinking, more targeted interventions such as roadside breath testing, physician advice and advertising bans were more cost-effective.

- 6.4 Brand et al, (2007) developed an Alcohol Policy Index to gauge the strength of a country's alcohol control policies. The Index generated a score that was based on policies in five areas – physical availability of alcohol, drinking context, alcohol prices, alcohol advertising and operation of motor vehicles – and was applied to the 30 countries that compose the OECD. Analysis was then carried out to examine the relationship between policy score and per capita alcohol consumption. Results showed a clear inverse relationship between policy strength and alcohol consumption. However, the authors do point out that there were a number of limitations to the study. For instance, the Index did not take into account the levels of enforcement in a country. Strict policies that are poorly enforced may be less effective than weaker policies that are well enforced. The study was also cross-sectional and therefore it could not take into account a time lag between enactment and impact on consumption nor was it possible to infer a causal link between laws and consumption. The Index was also unable to take cultural influences into consideration.

## 7 Conclusion

- 7.1 The review shows that the evidence on the impact of advertising on alcohol consumption is mixed and there is a lack of conclusive evidence regarding a causal link. The evidence from the research on the impact of advertising bans on consumption is also inconclusive.
- 7.2 In terms of future research, a number of analysts (eg Smith and Foxcroft, 2007, Grube and Waiters, 2005, ELSA report, 2005-2007, Cooke et al, 2002, Frank, 2008) have suggested further studies are needed including:
- analyses of alcohol advertising on the internet/impact of web 2.0
  - further longitudinal research examining the potential causal impact of advertising and consumption particularly with young people
  - longitudinal studies that take into account young people's cumulative knowledge, previous drinking behaviour and general disposition to advertisements
  - greater examination of substitution effects between beverages and between different media of advertising following advertising restriction
  - greater examination of marketing as a whole and not broadcast or print advertising in isolation
- 7.3 It was beyond the scope of this review to examine in detail the literature that is related to alcohol advertising regulations such as studies that examine the effectiveness of alternative policy options in their own right. Similarly, it was outside the remit of the review to examine more fully the causes or the factors that influence drinking trends and, more specifically, adolescent drinking, for example, peer group pressure, parental influence, socio-economic factors etc. Of relevance, however, is that to-date, there has been no research study that examines the impact of 'social networks' (i.e., friends, family and colleagues) as a factor in trends in alcohol consumption. There is also a limited amount of data/research looking at the link between advertising and misuse of alcohol.

## APPENDICES

## Appendix A – Summary table of research into advertising bans

STUDY	TYPE OF STUDY	DATA	CONCLUSIONS
Smart and Cutler (1976)	Interrupted time-series	British Columbia – yearly/monthly data of alcohol sales 1962-1972, following 14 month ban 1971-1972	Both yearly and monthly analyses of consumption showed no substantial effect of the ban
Ogborne and Smart (1980)	Interrupted time-series	Manitoba – monthly beer sales, 1970-1978 following restrictions of beer advertising in 1974	No evidence that beer consumption decreased following restrictions
Makowsky & Whitehead (1991)	Interrupted time-series	Saskatchewan - monthly data of alcohol sales 1981-1987 following lifting of 58 year old ban in 1983	No evidence of advertising leading to increased total sales but effects were beverage specific
Schweitzer et al (1983)	Cross-sectional/multi-variate	35 US states – 1975 – beer and spirits consumption	Evidence that ban on advertising leads to a shift from beer to spirits consumption but not to a reduction in total consumption
Hoadley (1984)	Cross sectional/multi-variate	48 US states – 1955-1980 – spirits consumption	No evidence that bans affected consumption but billboard restrictions were associated with higher consumption
Ornstein and Hanssens (1985)	Cross-sectional/multi-variate	50 US states/Columbia – 1974-1978 – beer and spirits consumption – 147/255 observations respectively	Evidence that control laws affecting price have greatest effect on consumption
Saffer (1991)	Cross-sectional/multi-variate	17 OECD countries – 1970-1983 – alcohol consumption	Evidence that countries with bans on broadcast advertisements have lower levels of alcohol consumption
Young (1993)	Cross-sectional/multi-variate	17 OECD countries – 1970-1983 – alcohol consumption	Evidence that bans do not decrease consumption but instead increase consumption for individual beverages
Calfee & Scheraga (1994)	Cross-sectional/multi-variate	France/UK/German/Netherlands – Sweden as a control – 1970-1991 – alcohol consumption	No evidence that bans decreased consumption
Saffer (1997)	Cross-sectional/multi-variate	76 USA television markets (ADIs) 1986-1989 – 1200 observations	Evidence of a significant relationship between alcohol and motor vehicle fatalities
Markovitz and Grossman (1998,2000)	Cross-sectional/multi-variate	1976/1985 – National Family Violence Survey/ - 1147/2675 parents with children respectively	No evidence of association between alcohol advertising and family violence
Nelson and Young (2001)	Cross-sectional/multi-variate	17 OECD countries – 1977-1995 – alcohol consumption	No evidence bans decreased alcohol consumption but broadcast bans led to greater alcohol consumption
Saffer and Dave (2002)	Cross-sectional/multi-variate	20 OECD countries – 1970-1995 – alcohol consumption	Evidence that alcohol advertising bans decrease alcohol consumption
Nelson (2003)	Cross-sectional/multi-variate	45 US states – 1982-1997 – alcohol consumption	Evidence that bans do not decrease consumption but billboard bans instead increase consumption for individual beverages
Saffer and Dave (2003)	Cross sectional/multi-variate	National Longitudinal Survey of Youth 1997	Complete ban of alcohol advertising would reduce both alcohol and binge participation
Dills et al (2004)	Cross-sectional/multi-variate	USA – 1900-1925 – alcohol consumption measured by drunkenness arrests during prohibition	Evidence of zero long term effect on drunkenness arrests – limited effect on alcohol consumption
Hollingworth et al (2006)	Cross-sectional/multi-variate	Bureau of the Census – 4m aged 20, 2000	Evidence that bans appear to have greatest potential for premature mortality reduction

## APPENDIX B – Bibliography

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## **Report 2**

# **The relationship between alcohol abuse and consumption patterns**

## 1. Introduction

- 1.1 Tuck's work, titled "Alcoholism and Social Policy" and published by the Home Office in 1980, challenged the belief held at that time that controlling problem drinking lies in devising policies that control overall consumption. Duffy's work (1991) provides some empirical evidence supporting Tuck's propositions.
- 1.2 The arguments put forward by Tuck challenge the premise that 'any increase in national consumption howsoever it may come about, will result in more people with alcoholic problems' or what Tuck refers to as the 'strong' consumption theory. This consumption theory was first put forward by Ledermann (1956) and is based on two assumptions:-
  - the dispersion of drinking frequencies within a given population is roughly constant
  - the differences of dispersion between populations with similar levels of per capita consumption is small.
- 1.3 Based on these assumptions, Ledermann argued that a log-normal distribution will always describe the distribution of drinking frequencies amongst a population. The implication of this theory is that an increase in per capita consumption of alcohol will always lead to an increase in heavy drinkers. It is this theory that Tuck challenges as the empirical evidence at the time had been poor and Ledermann's model had been heavily criticised as a result.
- 1.4 The issues which the 'strong' consumption theory fails to take into account are the changes in the socio-cultural, economic and situational factors that may help to explain the changes in behaviour and consumption patterns of alcohol. Tuck used survey data from the Target Group Index (TGI) provided by the British Market Research Bureau (BMRB) to show that ignoring gender, age and type of drink is not helpful when devising policy. Later work by Duffy, using a longer time-series, confirms the propositions put forward by Tuck.
- 1.5 This work focuses on updating Tuck and Duffy's work, mainly from a data perspective. It is important, as Tuck mentions in her own study, that a long time-series is used to test any propositions. This also extends the analysis to consider regional variations.

## 2. Data

### Introduction

- 2.1 A number of sources are used to determine an appropriate dataset to carry out this study. As the primary purpose is to update the work carried out by Tuck (1980) and Duffy (1991), the main source for this work is the British Market Research Bureau Target Group Index (TGI) survey data. The TGI data is one of the largest series available of continuous statistics on alcohol consumption in Great Britain.
- 2.2 Whilst the TGI data provides detailed statistics on trends in alcohol consumption, it does not contain a statistic measuring the average national consumption. This is needed to be able to test the so-called 'strong' consumption theory discussed earlier. National consumption data has been provided by World Advertising Research Centre (WARC). This dataset combines data from the Office of National Statistics (ONS) and HM Customs & Excise.

### Description

- 2.3 The TGI data is available in electronic format for the period 1988 to 2007. The pre-1988 data, covering the period 1975 to 1987, is only available in hard copy and was supplied in spreadsheet format by WARC. For the purpose of this study, the data was broken down by the following broad categories:-
- Sex
  - Age group
  - Drink type
  - Region
- 2.4 The data definitions are consistent in the sex, age and regional categories for the entire period. However, the categorical definitions for drink type, particularly beer, change throughout the period making it difficult to study the trends for that specific drink type. This is discussed in more detail in the relevant section.
- 2.5 The data on average national consumption is available consistently for the period 1981 to 2005. Therefore, a large part of this study will be limited to this time period. The data is broken down into the following categories:
- Total Alcohol
  - Beer
  - Cider & Perry
  - Still Light Wine
  - Sparkling Wine
  - Fortified Wine
  - Total Wine
  - Made Wine
  - Spirits
- 2.6 In this study we focus on total alcohol, beer, total wine and spirits. The unit of measurement is UK per capita consumption at 100% alcohol.

## Checks

- 2.7 The correct application of the statistical techniques used in this study requires that certain conditions be met. For instance, when calculating a simple correlation coefficient<sup>5</sup> it is assumed that the data is normally distributed. Failing to meet this assumption, it is necessary to consider using other correlation measures which fall within the group of non-parametric methods of estimation. One such measure is the Spearman correlation coefficient<sup>6</sup>.
- 2.8 As correlation coefficients are used extensively in this study, we start by testing the normality of each of the series used in the analysis. The results are detailed in Appendix I. This shows that the assumption of normality does not hold in a significant number of series. Where this is the case, the Spearman correlation method will be used instead of simple correlations.
- 2.9 Any other data issues are discussed within the relevant sections.

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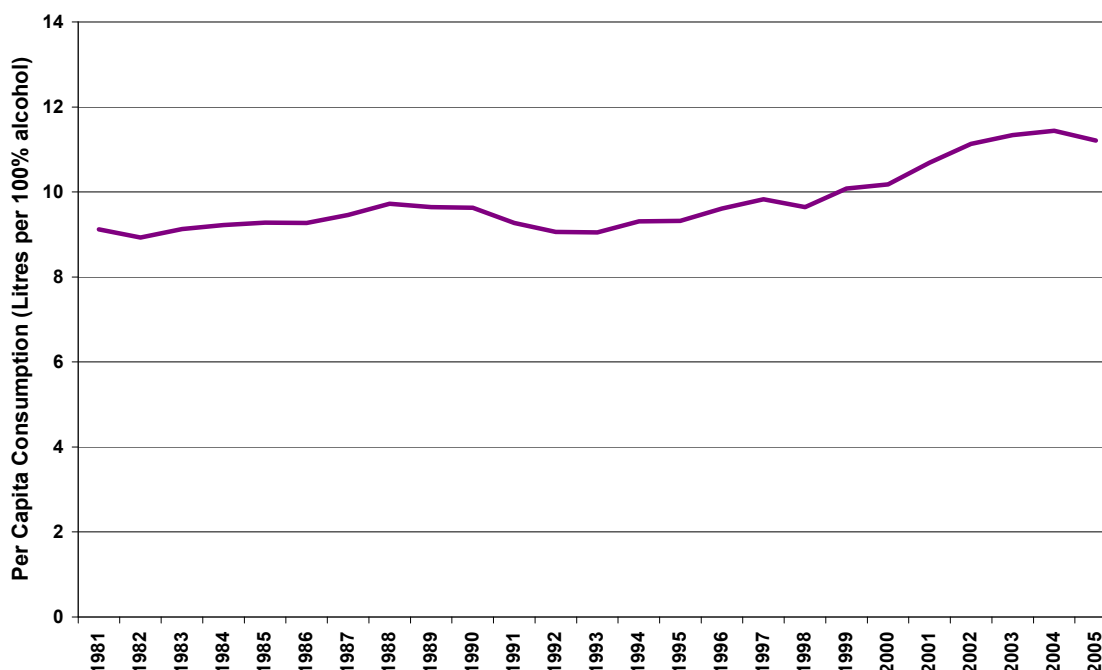
<sup>5</sup> This is sometimes referred to as a Pearson correlation coefficient

<sup>6</sup> Spearman, C. (1904), "The Proof and Measurement of Association between Two Things", *American Journal of Psychology*, 15, pp. 72 – 101.

### 3. Trends in National Average Consumption

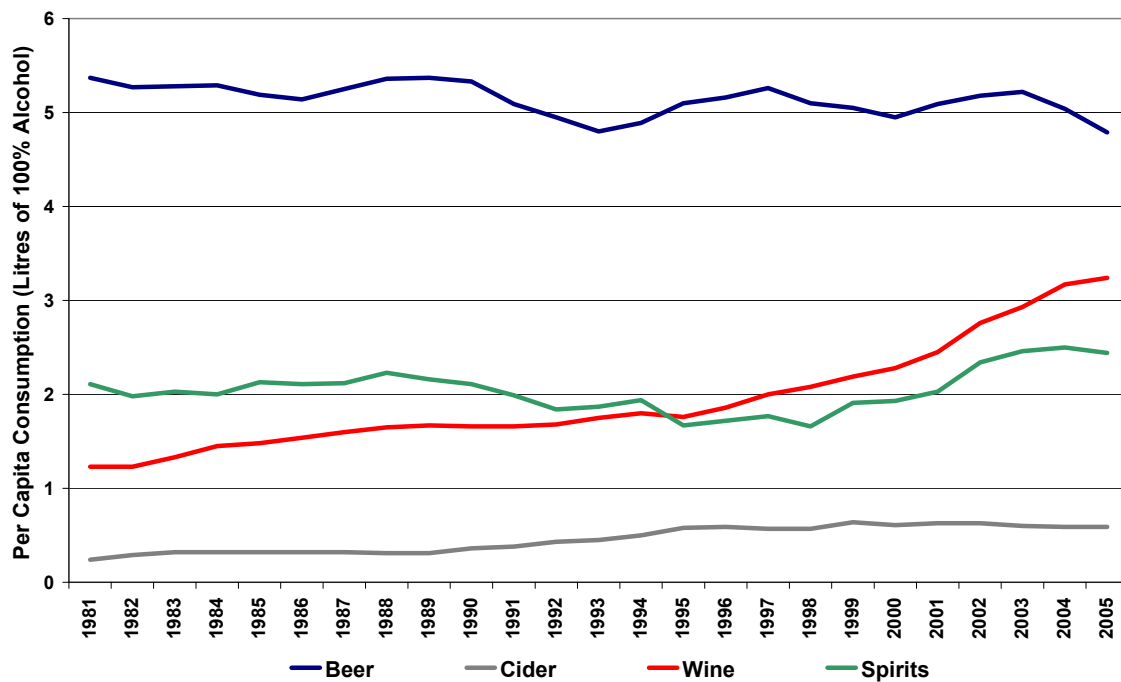
- 3.1 We begin our analysis by looking at the national trends in average alcohol consumption over the period 1981 to 2005. Figure 1 shows the patterns in total alcohol consumption over the period. This shows that average alcohol consumption increased over the period from 9.12 litres of 100% alcohol in 1981 to 11.21 litres of 100% alcohol in 2005, an increase of 23 per cent. The rate of increase in average consumption is clearly not uniform across the period with average consumption increasing much faster over the last ten years. The trend in average consumption over the period 1981 to 1995 is generally stable.

Figure 1: National average alcohol consumption, Litres at 100% alcohol



- 3.2 However, the pattern of consumption is very different across different drink types as shown in figure 2. We consider four different types of alcoholic drinks, namely beer, cider, wine and spirits. It is clear that wine shows a consistent upward trend throughout the period, increasing from 1.23 litres in 1981 to 3.24 litres in 2005, an increase of over 160 per cent. Except for beer, all the other beverage types show an increase over the period, albeit a more modest one compared with wine. Beer shows a stable trend over the period with the latest figures actually showing a drop from those in 1981.

Figure 2: Per capita consumption, Litres at 100% alcohol by beverage type



3.3 It is not the aim of this study to analyse the reasons for the changes in these trends. It aims to look at whether the increase in overall alcohol consumption or, indeed, an increase in the average consumption of different types of drink leads to an increase in the proportion of frequent drinkers. We, therefore, move to considering the relationship between average national consumption and the frequency of consumption.

## 4. The Frequency of Consumption

### Total Population

- 4.1 The TGI data relating to the frequency of alcohol consumption contains the following categories:-
- Never drink
  - Less than once a week
  - Once a week
  - Two or three times a week
  - Daily
- 4.2 Figure 3 shows the distribution of consumption frequency for the categories covering the period 1975 to 1987 and figure 4 shows the same distribution for the period 1988 to 2007. The reason for dividing the datasets is because the 'Never' category was not broken out pre-1988. It appears that the 'Never' category has been aggregated with the 'Less than once a week' category. Our assumption is that the impact of this issue on the actual analysis is minimal as the categories of interest are the high frequency categories and there is a sufficient time period to consider the 'Never' category. Three of the categories, namely 'Once a week', 'Two or three times a week', and 'Daily' are consistent throughout the dataset. Also, the dataset required for the update which covers the period post-1989 is consistent in its definitions.
- 4.3 In contrast to the distributions of consumption frequency shown in Duffy and the distribution shown in figure 3, figure 4 shows that the proportion of respondents reporting that they have never drunk has been rising consistently over the period 1988 to 2007. Over the period, the proportion of 'Never' respondents nearly trebled from 6.2% in 1988 to 15.2% in 2007. This subsequently means that the proportion of drinkers has been falling. Tables 1 and 2 show the change in the proportion in each of the categories. Over the period 1975 to 1987, the distributions seem to be stable. However, there are some significant changes over the period 1988 to 2007 where there appears to be a shift from the lowest frequency categories into the 'Never' and high frequency categories.

Figure 3: Frequency of consumption, All Adults – 1975 to 1987

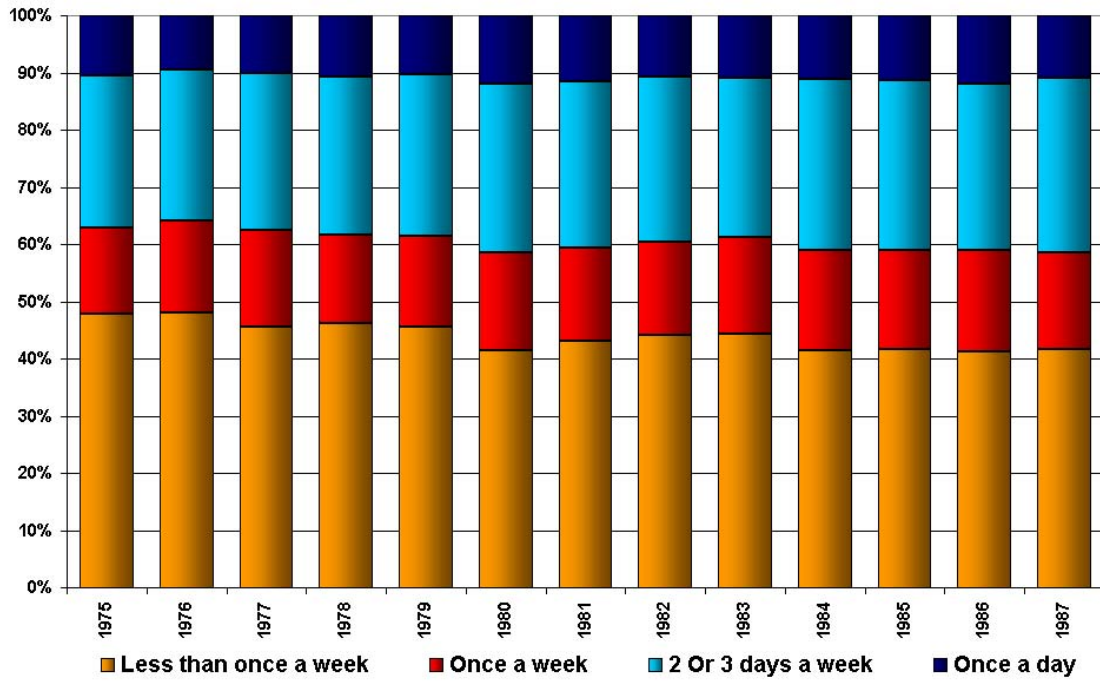
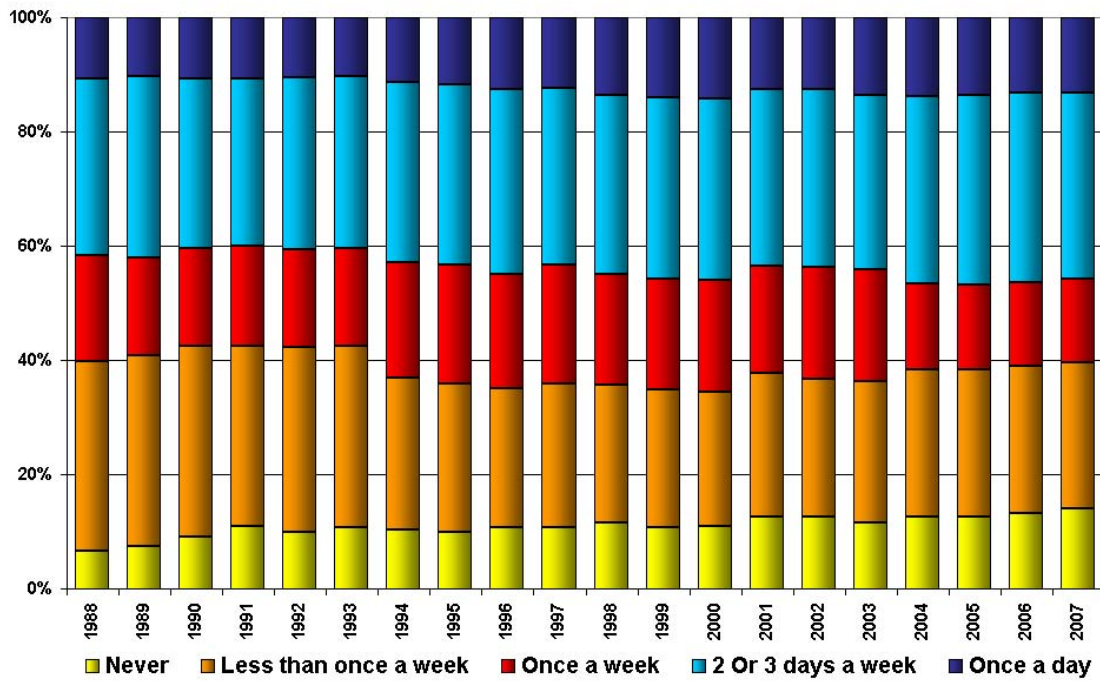


Figure 4: Frequency of consumption, All Adults – 1988 to 2007



*Table 1: Change in the proportion of respondents in each category – 1975 to 1987*

Category	Proportion 1975 (%)	Proportion 1987 (%)	Percentage Change (%)
Once A Day	10.5	10.9	3.9
2 Or 3 Days A Week	26.6	30.5	14.9
Once A Week	15.1	16.9	12.0
Less Than Once A Week	47.8	41.7	-12.6

*Table 2: Change in the proportion of respondents in each category – 1988 to 2007*

Category	Proportion 1988 (%)	Proportion 2007 (%)	Percentage Change (%)
Once A Day	10.2	14.2	39.0
2 Or 3 Days A Week	29.3	35.3	20.6
Once A Week	17.7	15.7	-11.0
Less Than Once A Week	31.4	27.5	-12.4
Never	6.2	15.2	145.6

- 4.4 We move to testing whether there is a relationship between average national consumption and the various frequency categories. As in Tuck and Duffy we use the correlation coefficient to test for this association. A simple correlation coefficient is normally used but a Spearman correlation coefficient is used where the data series does not pass the normality test as reported in Appendix I. Furthermore, as in Duffy, we construct a population average frequency of drinking series where the sample proportions drinking in each frequency categories are weighted by the constants, 0, 0.25, 1, 3 and 7. With regard to the data pre-1988, results for the 'Average frequency', 'Less than once a week' and 'Never' series are not reported due to the reasons discussed above. Also, as we are unable to obtain a series of the overall size of the sample pre-1988, it is also not possible to report on the results for the 'Proportion of drinkers' category. Table 3 reports on the correlation coefficients between each of the categories and average national consumption of alcohol over selected time periods.

*Table 3: Correlation coefficients between the average national consumption and the frequency of consumption over selected time intervals*

	1981 – 1989	1988 - 2005	1981 - 2005
Average frequency in days	N/A	0.757	N/A
Proportion of Drinkers	N/A	-0.502	N/A
Daily	-0.433	0.764	0.775
2 to 3 times a week	0.650	0.698	0.763
Once a week	0.533	-0.022	0.192
Less than once a week	N/A	-0.422	N/A
Never	N/A	0.661	N/A

- 4.5 The results in table 3 show that there has been a change in the relationship from the one reported in Tuck and later Duffy. The most important observation is the strong correlation between average national consumption and the proportion of daily drinkers. The previous studies reported a negative relationship between the two series which is similar to the relationship found here over the period 1981 to 1989. However, the relationship seems to have changed over the extended time period with the results showing a correlation coefficient of 0.757 over the 1988 to 2005 period and 0.798 over the 1981 to 2005 period. Similarly, the '2 to 3 times a week' category shows strong positive correlation over all the time periods.
- 4.6 The results are, therefore, inconsistent with the findings of Tuck and Duffy with regards to overall alcohol consumption and actually provide evidence in support of the Ledermann theory as they indicate that changes in average national consumption are associated with changes in the proportion of people drinking at high frequency.
- 4.7 However, one other important observation is the strong positive correlation between the changes in average national consumption and changes in the proportion of people not drinking. This relationship is worth exploring as it appears that there certainly is a significant change in the distributions of non-drinkers over the period, with the proportion of the population in either extremes growing significantly. This is supported by the negative relationship between the changes in average national consumption and the proportion of the population in the lowest frequency categories.

### Population Subgroups

- 4.8 Following the approach in Duffy, the analysis carried out on population subgroups consider the association between trends in these subgroups and no within-subgroup analysis has been performed. This is due to the fact that it is not possible to construct national average figures at the population subgroup level.
- 4.9 We begin by looking at the frequency of consumption data broken down by men and women. The results are shown in figures 5 to 8. Similar to the overall frequency of consumption data, two time periods are considered, 1975 to 1987 and 1988 to 2007 due to changes in the frequency categories. The trends shown in the figures below suggest that men and women have experienced a similar trend in the frequency of consumption to that seen in the overall case above. The proportion of high frequency drinkers in the period 1988 to 2007 and the proportion of non-drinkers have increased. However, for women drinkers, the period 1975 to 1987 saw a vast increase in the proportion of high frequency drinkers whilst, over the same period for men, the proportion of high frequency drinkers remained stable.

Figure 5: Frequency of consumption, Men only – 1975 to 1987

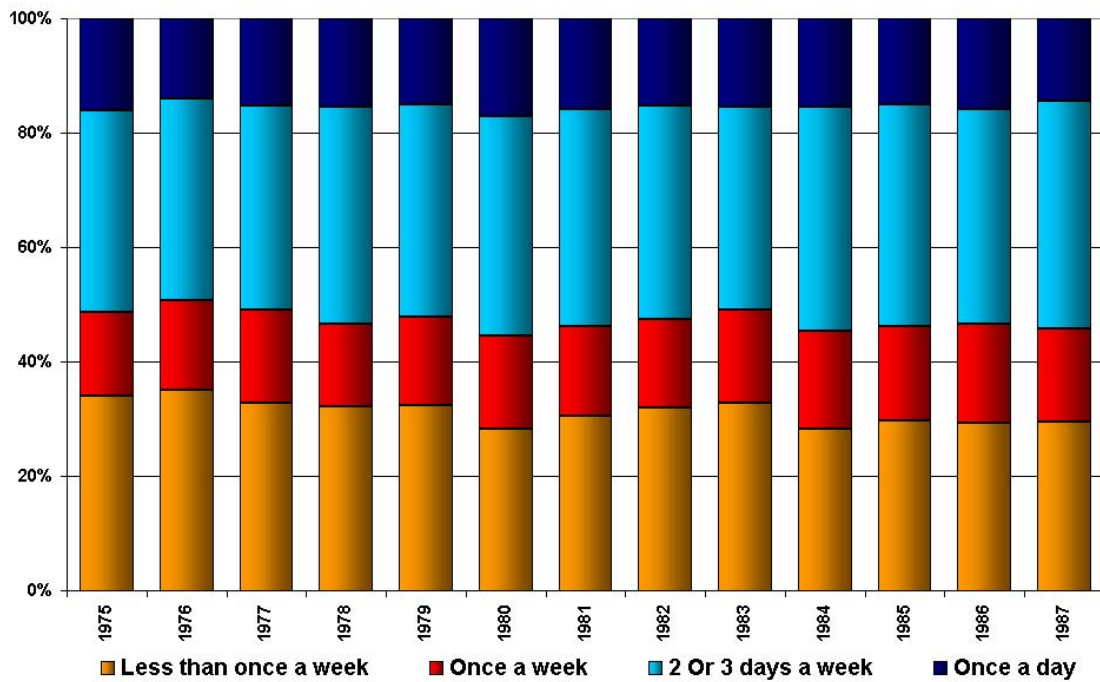


Figure 6: Frequency of consumption, Men only – 1988 to 2007

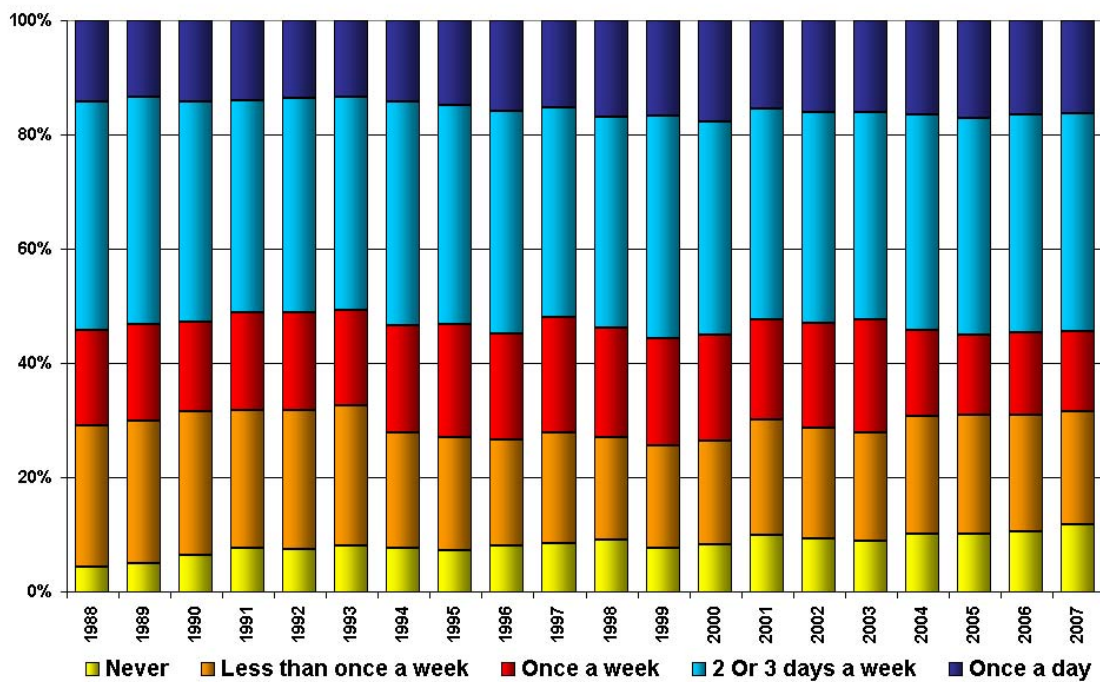


Figure 7: Frequency of consumption, Women only – 1975 to 1987

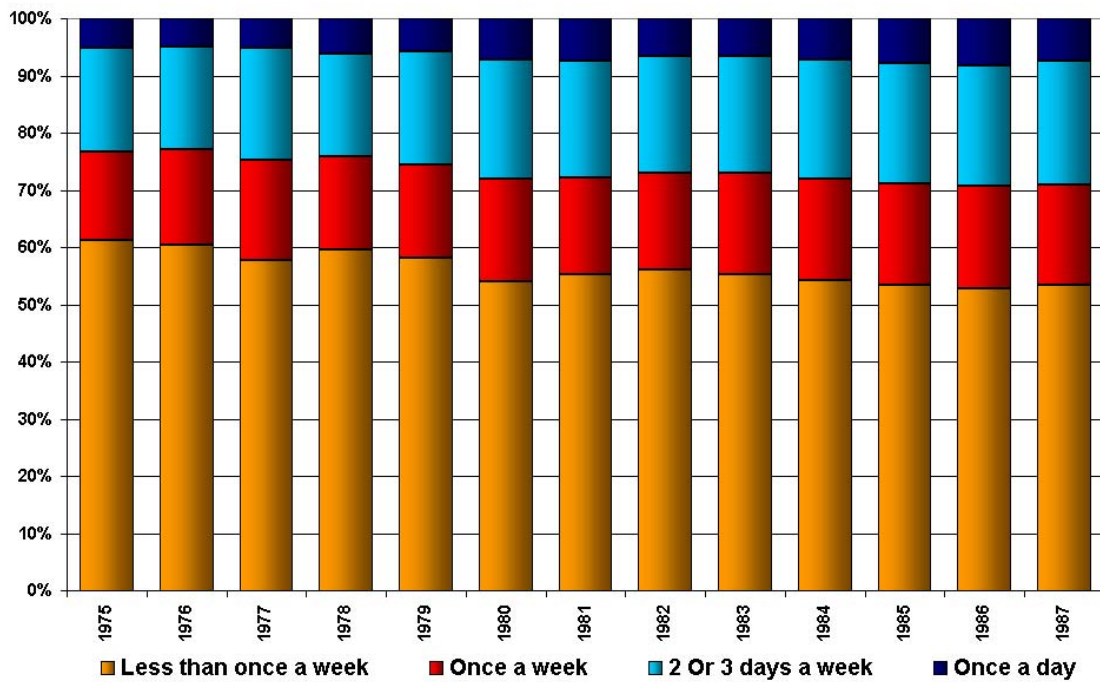
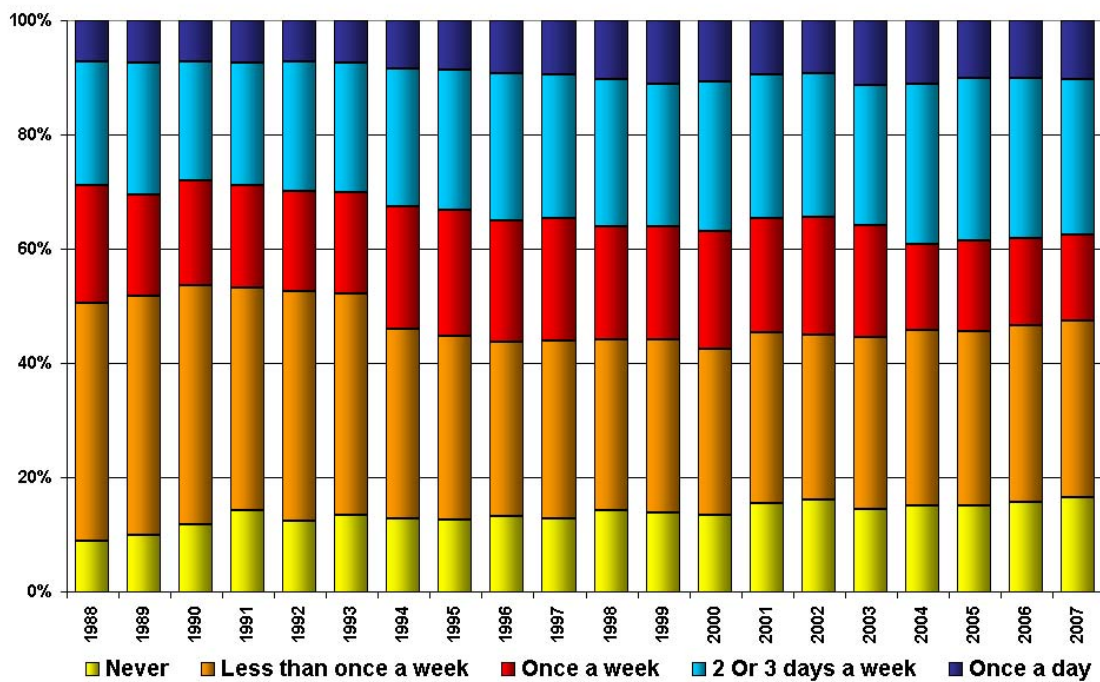


Figure 8: Frequency of consumption, Women only – 1988 to 2007



4.10 The above trends are reflected in the correlation coefficients between men and women drinkers shown in table 4. The magnitude of the correlation coefficients suggests a strong positive relationship between men and women drinkers over the selected time intervals, except for the proportion of daily drinkers over the period 1975 to 1989. The results from the earlier time interval confirm the results shown in Duffy that, although the trends in consumption between men and women are similar, the degree of correlation is not high. However, the results from the other time intervals, not covered by Duffy, suggest that there has been a change in the strength of the relationship with the correlation coefficients between daily men and women drinkers increasing sharply. This weakens the argument regarding the existence of different trends amongst subgroups of the population.

*Table 4: Correlation coefficients between male and female drinkers over selected time intervals*

	1975 – 1989	1988 - 2007	1975 - 2007
Average frequency in days	N/A	0.936	N/A
Proportion of Drinkers	N/A	0.953	N/A
Daily	0.121	0.862	0.644
2 to 3 times a week	0.782	0.534	0.504
Once a week	0.661	0.864	0.868
Less than once a week	N/A	0.882	N/A
Never	N/A	0.899	N/A

4.11 The work by Duffy also considered the consumption patterns of young drinkers, those in the 15 – 19 age group. The distributions are shown in figures 9 to 12 and tables 5 to 7 show the correlation coefficients between different categories of drinking frequencies between men and women drinkers, including young and overall drinkers. The previous study by Duffy suggests that, with the exception of the correlation between all women and young women, there is a positive correlation between the frequency categories in the population subgroups considered, but due to small size correlation coefficients, the relationships are not very strong. These findings are used to support the previous findings in Tuck (1979) regarding the existence of sub-markets within the alcohol market. Whilst the results for the period 1975 to 1989, shown in table 5, add support to this argument, results from the more recent time intervals seem to suggest otherwise.

4.12 For instance, the correlation coefficient between all female and young female daily drinkers suggests that there has been a shift in that relationship. In Duffy, the relationship between the two subgroups was negative, which is also supported by the results in this study for the period 1975 to 1989. The results for the period 1987 to 2007, however, show strong positive correlation between the two subgroups. For the overall period 1975 to 2007, the correlation is positive but not strong. There appears to have been a change in the relationship in recent years. The results for the other categories over the period 1987 to 2007 also show that there generally is strong positive correlation between the different subgroups. There is no evidence, therefore, that there are different sub-markets within the overall alcohol market based on this analysis alone.

Figure 9: Frequency of consumption, Young Men only – 1975 to 1987

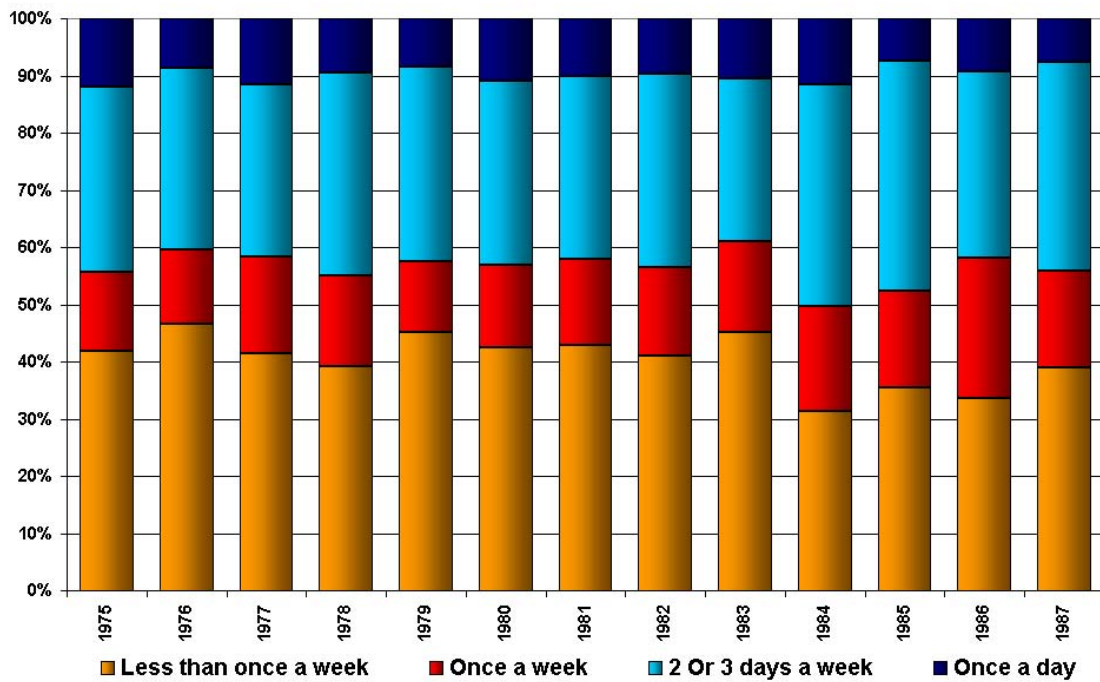


Figure 10: Frequency of consumption, Young Men only – 1988 to 2007

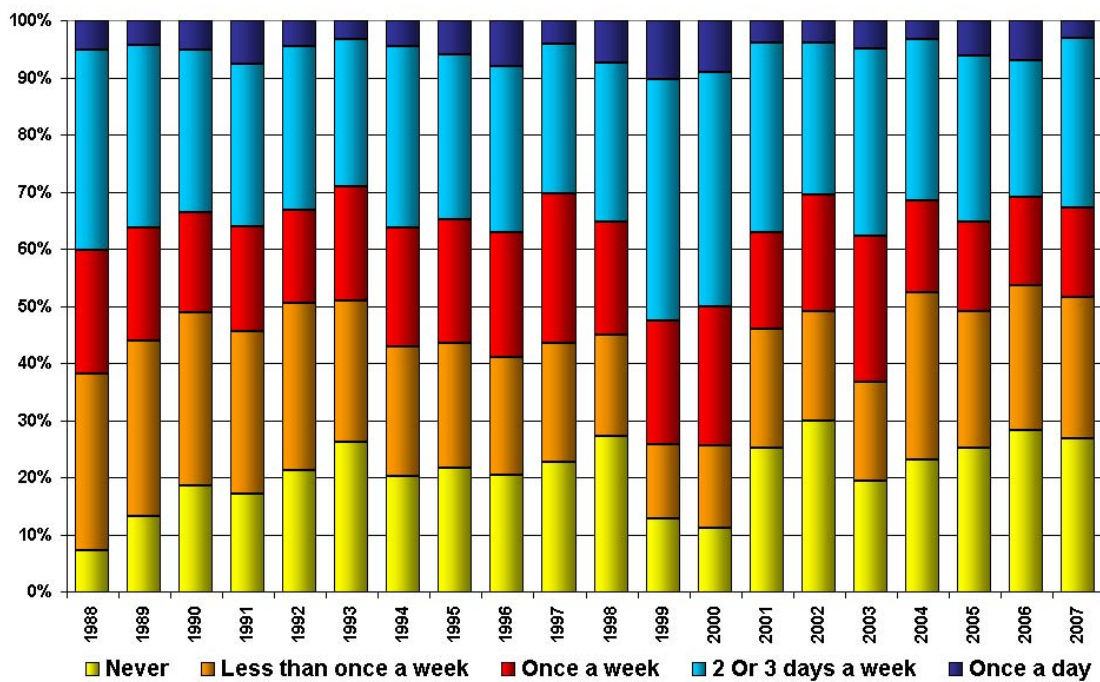


Figure 11: Frequency of consumption, Young Women only – 1975 to 1987

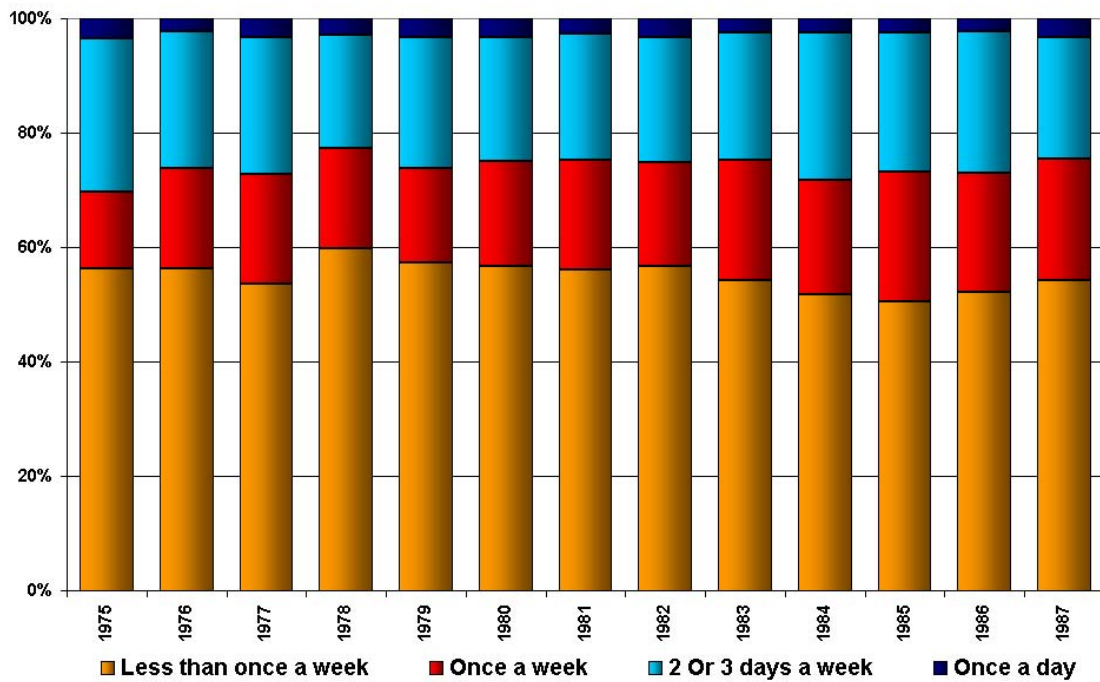


Figure 12: Frequency of consumption, Young Women only – 1988 to 2007

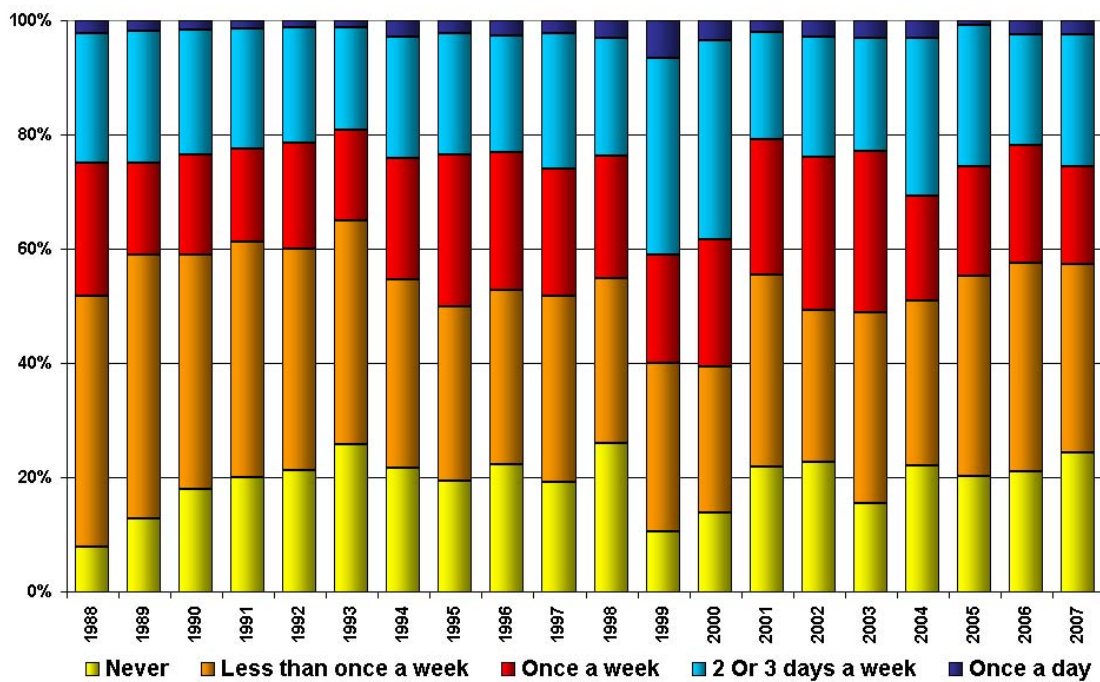


Table 5: Correlation coefficients between aspects of drinking patterns in young males and females and total males and females, 1975 to 1989

	Young Female			All Male		
	(1)	(2)	(3)	(1)	(2)	(3)
Young Male Proportion of Drinkers (1)	N/A			N/A		
Young Male Average Frequency (2)		N/A			N/A	
Young Male Proportion of Daily Drinkers (3)			0.489			0.804
All Female Proportion of Drinkers (1)	N/A					
All Female Average Frequency (2)		N/A				
All Female Proportion of Daily Drinkers (3)			-0.268			

Table 6: Correlation coefficients between aspects of drinking patterns in young males and females and total males and females, 1988 to 2007

	Young Female			All Male		
	(1)	(2)	(3)	(1)	(2)	(3)
Young Male Proportion of Drinkers (1)	0.811			0.832		
Young Male Average Frequency (2)		0.567			0.462	
Young Male Proportion of Daily Drinkers (3)			0.302			0.269
All Female Proportion of Drinkers (1)	0.667					
All Female Average Frequency (2)		0.758				
All Female Proportion of Daily Drinkers (3)			0.642			

Table 7: Correlation coefficients between aspects of drinking patterns in young males and females and total males and females, 1975 to 2007

	Young Female			All Male		
	(1)	(2)	(3)	(1)	(2)	(3)
Young Male Proportion of Drinkers (1)	N/A			N/A		
Young Male Average Frequency (2)		N/A			N/A	
Young Male Proportion of Daily Drinkers (3)			0.548			0.299
All Female Proportion of Drinkers (1)	N/A					
All Female Average Frequency (2)		N/A				
All Female Proportion of Daily Drinkers (3)			0.319			

### In-depth Statistical Analysis

- 4.13 In this section, we consider the statistical testing techniques applied by Duffy to extend the analysis. Duffy uses log-linear modelling to relate the numbers of individuals in each frequency category to national average consumption and fits linear and quadratic components of consumption. We replicate this analysis using the longer time-series available for the categories where there are consistent observations for the period 1981 to 2005.
- 4.14 The results are shown in tables 8 and 9 for the categories: daily drinkers, 2 to 3 times a week and once a week. Firstly, the results show that the quadratic term has no significant impact on the analysis as it is highly correlated with the non-squared consumption term and therefore, this is removed and the results without the squared term is shown in table 9. This reflects the results from the correlation coefficients. The R-squared term, which measures the amount of variation in the amount of people in each frequency category explained by the changes in national average consumption, shows that a large amount of variation is explained for the higher frequency categories. The coefficients are also highly significant as indicated by the t-values.

*Table 8: Regression results by frequency category with squared consumption term*

	Constant	National Average Consumption	Squared Consumption	R-Squared
Daily drinkers	4.91 (1.52)	0.59 (0.92)	-0.02 (-0.72)	0.68
2 - 3 times a week	7.76 (3.99)	0.27 (0.70)	-0.01 (-0.52)	0.63
Once a week	-0.08 (-0.02)	1.76 (2.25)	-0.09 (-2.23)	0.19

(T-values shown in parentheses)

*Table 9: Regression results by frequency category without squared consumption term*

	Constant	National Average Consumption	R-squared (%)
Daily drinkers	7.23 (40.09)	0.13 (7.08)	0.68
2 - 3 times a week	8.77 (81.22)	0.07 (6.32)	0.62
Once a week	8.74 (36.22)	0.02 (0.71)	0.02

(T-values shown in parentheses)

## 5. Consumption by Type of Drink

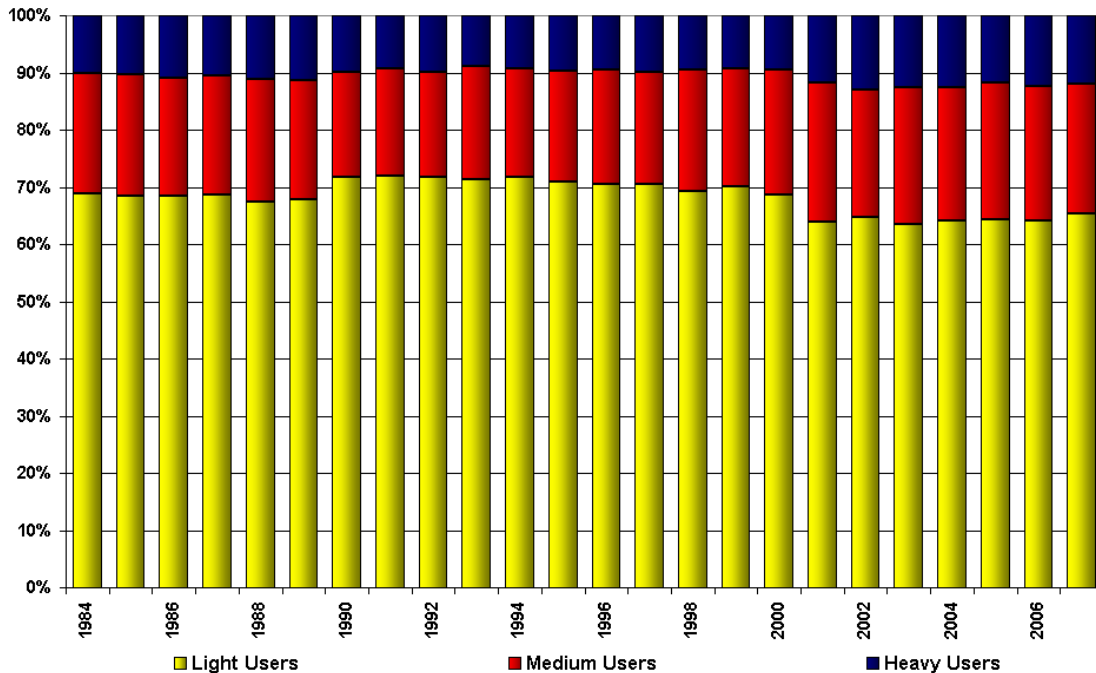
- 5.1 The national average consumption data for overall alcohol consumption and average consumption by alcohol type, shown in figures 1 and 2, show that although beer consumption still accounts for over 40% of alcohol consumption, it has fallen from 58.9% in 1975 to 42.7% in 2007. Consumption of wine, on the other hand, has increased from 13.5% to 28.9% in 2007. Studying the trends between the different types of alcohol, therefore, is important to understand why there has been an increase in the proportion of high frequency drinkers.

### Beer

- 5.2 When the study by Duffy was conducted, a consistent and sufficiently long series on beer consumption by categories was not available due to the changes in the constituents of the TGI beer series. More specifically, lager figures were reported separately since 1983/84 as the importance of lager increased. As the series is extended in this study, it is now possible to consider figures for beer consumption using the draught lager series. We chose this series as the number of respondents drinking lager in the TGI data remains stable over the period, whereas this is not the case for other types of beer. Furthermore, the draught lager series contains the largest amount of respondents when compared with the other types of beer. The analysis in this section will cover the period 1984 to 2007 where possible. This contains a sufficient number of observations for a useful exercise.
- 5.3 The TGI data on the amount of consumption is split into three categories: 'light', 'medium' and 'heavy' users. 'Light' users include those who drank less than 3 pints in the last week, 'medium' users are those respondents who drank 3 to 7 pints in the last week and 'heavy' users are respondents who reported drinking 8 pints or more in the last week. As opposed to the overall alcohol data which reports on the frequency of drinking, the data by alcohol type looks at the amount of alcohol drunk. This may give a better indication on the relationships suggested by the Ledermann theory than the TGI frequency data. The frequency data would classify those drinking a small bottle of beer while watching TV every night as high frequency drinkers and weekly binge drinkers as less frequent drinkers - it does not show that the former group drink significantly less alcohol than the latter.
- 5.4 Figure 13 shows the distribution of consumption for draught lager over the period 1984 to 2007. This shows that the distribution is generally stable over the period with a very small increase in the proportion of heavy drinkers over the last few years. In terms of the relationship between national average beer consumption and heavy consumption of lager, the correlation coefficient is 0.263, which does not suggest any strong relationship between the two quantities and certainly does not provide any empirical evidence for the Ledermann theory. Furthermore, the proportion of heavy drinkers has increased from 10.2% in 1984 to 11.6% in 2007. This increase is very small and not significant which is, indirectly, inconsistent with the Ledermann theory.

- 5.5 It is worth noting that the national average beer series includes other types of beer and not only draught lager but as draught lager seems to be the type of beer most consumed, it is sufficient to consider the relationship with draught lager only. Furthermore, the national average beer series covers the period 1981 to 2005 and therefore the correlation coefficient relates to the period 1984 to 2005, missing the years 2006 and 2007 which are included in the TGI series.

Figure 13: Distribution of consumption, Draught Lager – 1984 to 2007



## Wine

- 5.6 A consistent and long series for wine is available for the full period as the 'bottled wine' category is available throughout the period. The categories are split into 'light', 'medium' and 'heavy' users. With 'light' users including those respondents who drank less than 1 bottle in the last month, the 'medium' category includes respondents who drank 1 to 2 bottles in the last month and the 'heavy' category consists of respondents who drank 3 bottles or more in the last month.
- 5.7 Figure 14 shows the distribution of wine drinking over the period 1975 to 2007 broken down by the categories: 'light', 'medium' and 'heavy'. This shows a dramatic increase in the proportion of heavy drinkers over the period, rising from 15.3% in 1975 to 41.2% in 2007. We also find the correlation coefficient between the average national consumption figure for wine and the proportion of heavy drinkers to be 0.92. This finding seems to support the Ledermann theory. But, it is also important to consider a number of other factors that could influence this finding.
- 5.8 First, we consider the proportion of the population that drink wine. Duffy has reported that over the period 1978/9 to 1988/9, this has increased from 50.6% to 68.0%. The extended series used in this study shows that this figure has actually fallen to 64.6% of the population in 2007. This suggests that, since 1988/9, the proportion of wine drinkers has remained stable. The assertion, therefore, that this provides some explanation to the changes in the distribution of consumption is weak.

5.9 Second, we have looked at the constituents of the various categories and more specifically the 'heavy' drinker category. As pointed out earlier, all drinkers of 3 bottles or more last month are classified as heavy drinkers. This is a very broad category and we explore it here further. The distribution by number of bottles drunk in the 'heavy' category as reported in the TGI data is shown in figure 15. This shows that the proportion of people in the 'heavy' category drinking 5 or more bottles has been increasing over the period 1988 to 2007. This suggests that the increase in 'heavy' drinkers is due to those drinkers in the highest ranking category in terms of number of bottles drunk in the last month.

Figure 14: Distribution of consumption, Bottled Wine – 1975 to 2007

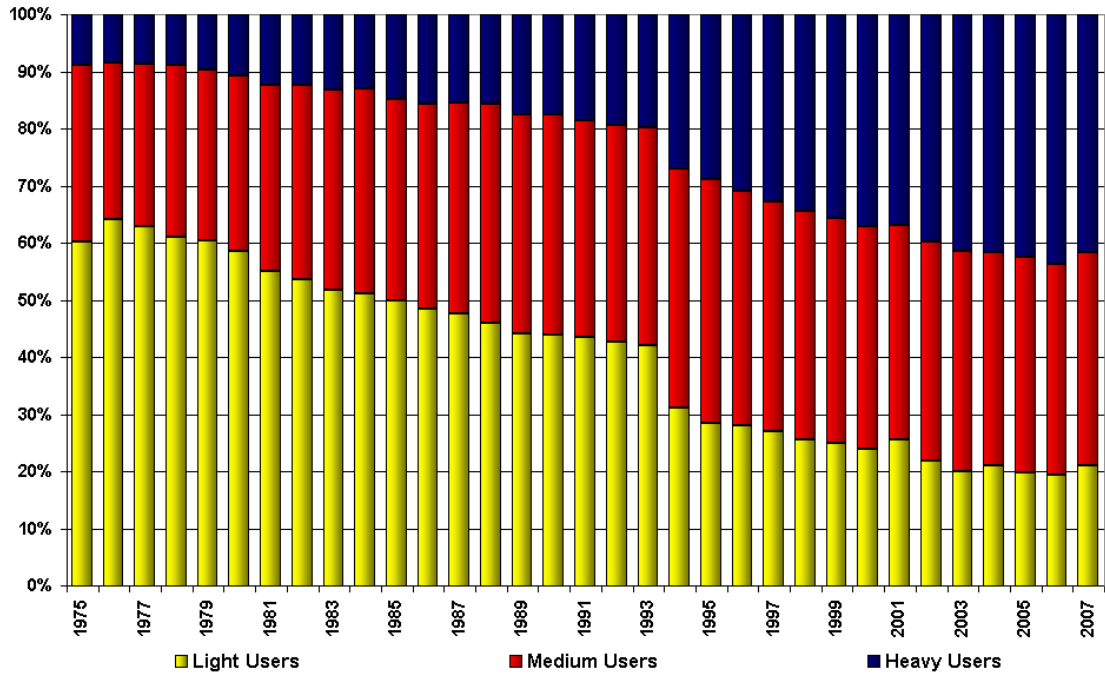
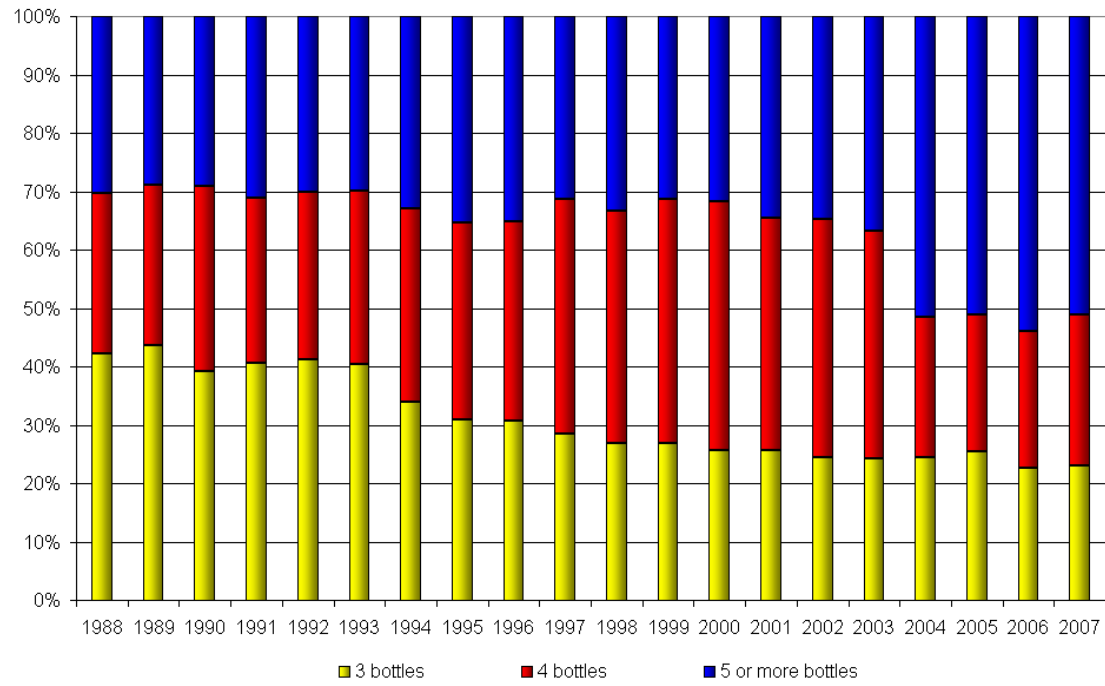


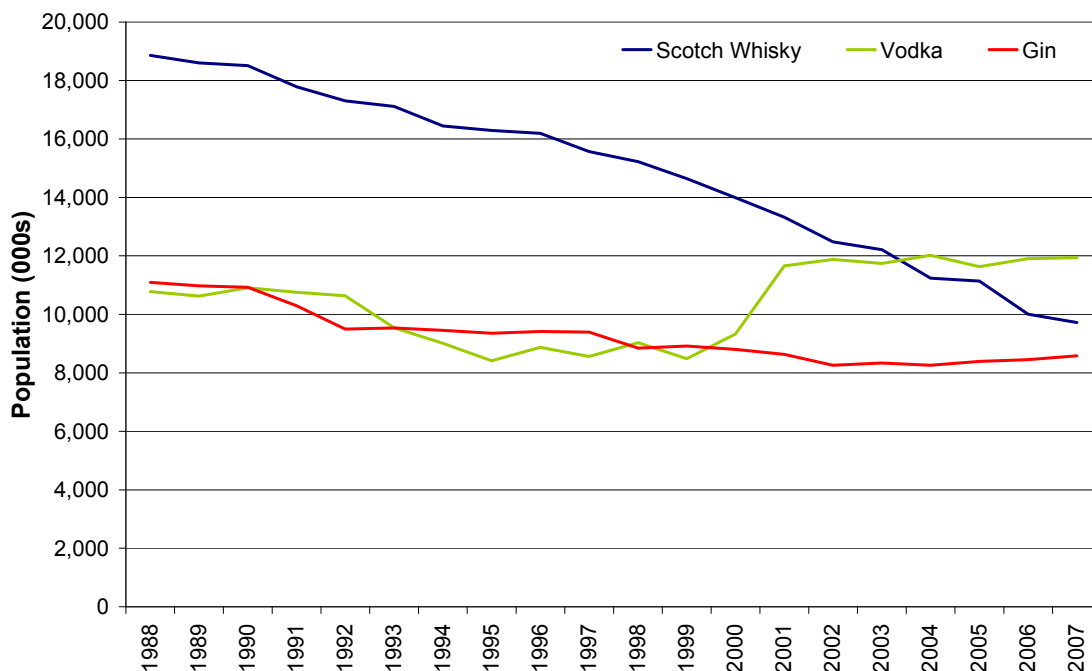
Figure 15: Distribution of consumption of wine in the 'heavy' category, 1988 to 2007



## Spirits

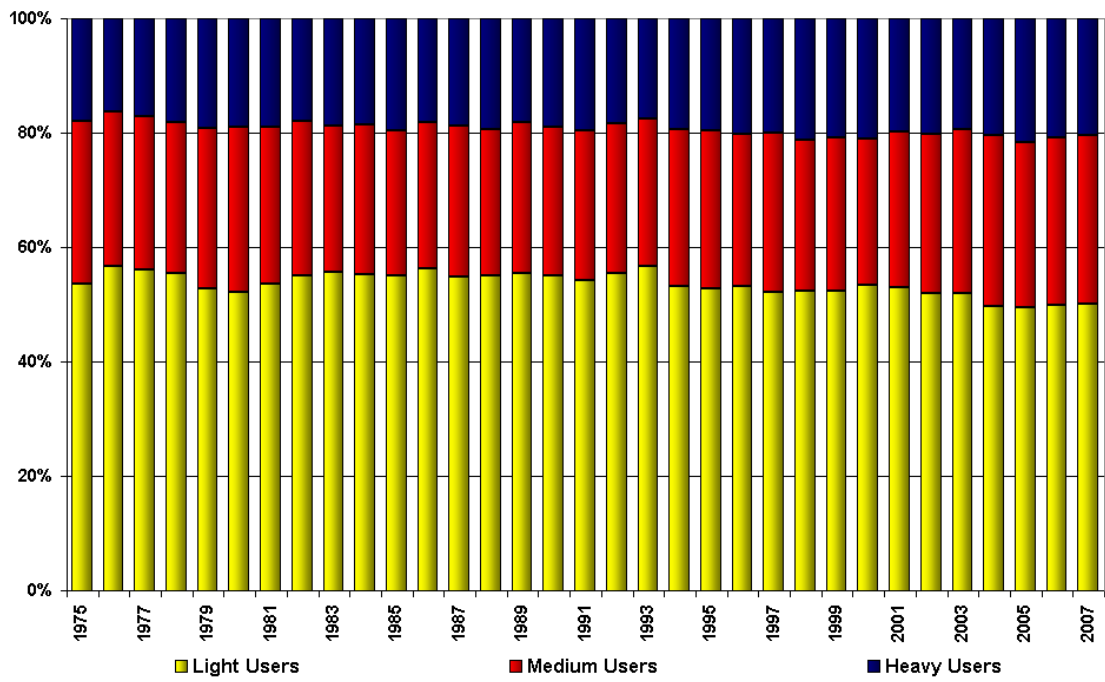
- 5.10 In Tuck's study, whisky is used to study the consumption patterns of spirits and Duffy uses whisky and Scotch whisky. The reason behind using this is the importance of whisky as a drink, representing over half of alcohol consumption from spirits. In here, for consistency we will also use the series for Scotch whisky to represent this type of drink but we also need to bear in mind that whisky is no longer the dominant spirit. Figure 16 shows the population of drinkers by spirit type for three types of spirits, Scotch whisky, vodka and gin as reported in the TGI database for the period 1988 to 2007. This shows that the population of whisky drinkers has been falling consistently for the period and is the dominant drink only for the earlier years.
- 5.11 This, however, does not seem to have an impact on the distribution of whisky drinkers by the amount they drank during the period as shown in figure 17.<sup>7</sup> The distribution remains stable with no obvious changes to the proportions at the three categories: 'light', 'medium' and 'heavy' drinkers. The 'light' category includes respondents drinking 2 measures or less in the last month, 'medium' includes those drinking 3 or more measures last month to 2 measures last week, and 'heavy' contains those drinking more than 3 measure in the last week. In terms of the correlation between 'heavy' whisky drinkers and the national average consumption of spirits, we find that the correlation coefficient is a very low 0.051. This is contrary to the predictions of the Ledermann theory.

Figure 16: Population of spirit drinkers by drink type, 1988 to 2007



<sup>7</sup> It is worth noting that before 1981, there was no separate series for Scotch whisky, and the series contains all types of whisky, but as Duffy pointed out, this does not seem to affect the distribution of consumption.

Figure 17: Distribution of consumption, Scotch whisky – 1975 to 2007



5.12 For completeness, we consider the distribution of consumption for the two other spirits mentioned: vodka and gin. This is shown in figures 18 and 19 for the period 1988 to 2007. This shows that there has been an increase in the proportion of 'heavy' drinkers for both gin and vodka, but more so for vodka. In terms of the relationship between the proportion of heavy drinkers in these drink types and the national average consumption of spirits, we find correlation coefficients of 0.276 and 0.472 for gin and vodka respectively. This suggests that despite the relationships not being strong for gin, there is a relationship between national average consumption of spirits and the proportion of 'heavy' vodka drinkers. This contradicts the findings of Tuck and Duffy with regards to spirits.

Figure 18: Distribution of consumption, Gin – 1988 to 2007

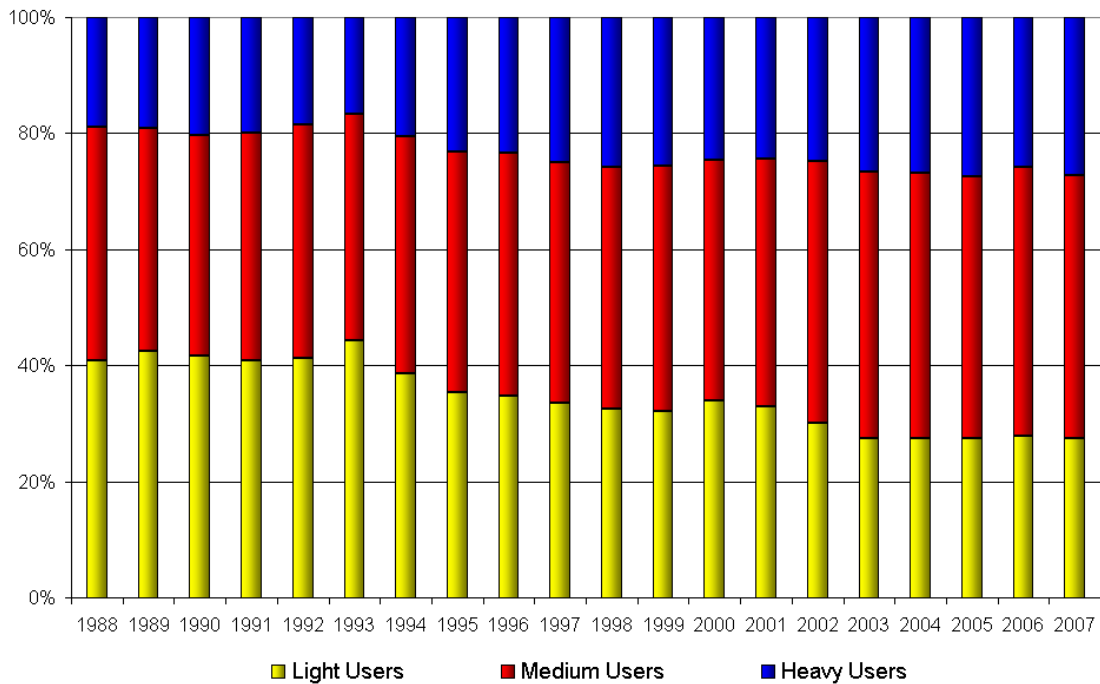
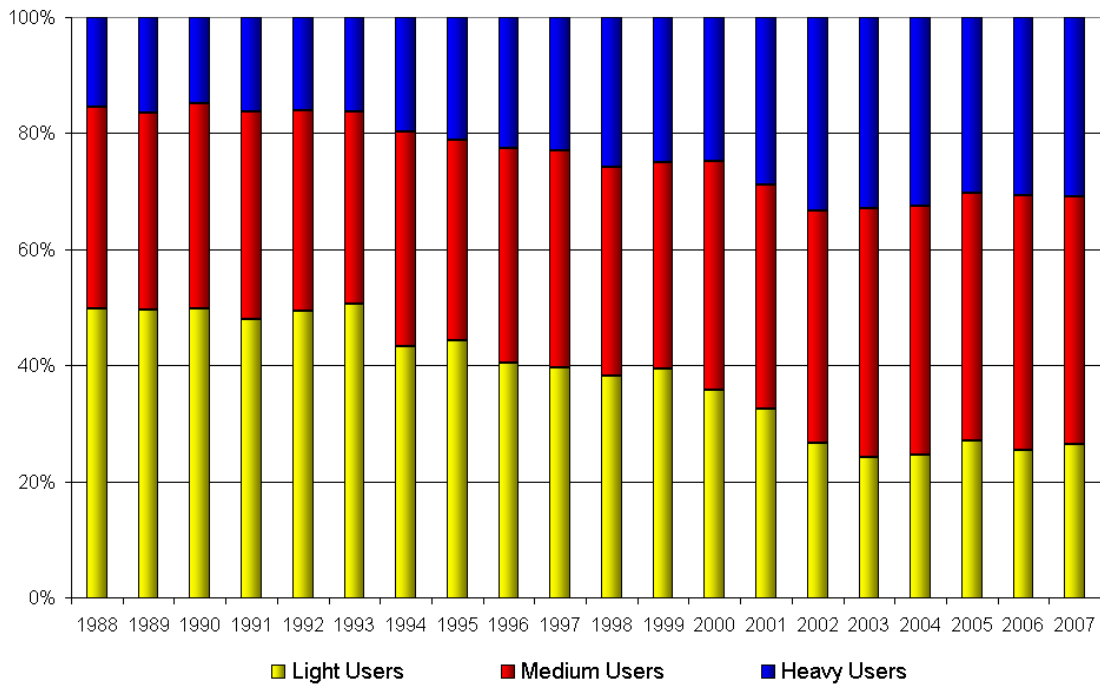


Figure 19: Distribution of consumption, Vodka – 1988 to 2007



## 6. Regional Variations

- 6.1 In our regional analysis we have focussed on the North region, this includes Northumbria police region. The reason for focussing on this region is that evidence indicates that misuse of alcohol is higher in this region eg. in 2007/8 the number of women who were arrested for being drunk and disorderly in Northumbria was 2,101 as compared with only 204 arrests in Essex and 731 arrests in the West Midlands.
- 6.2 First, we have considered a summary of the regional differences in the proportion of drinkers in the different frequency of drinking categories discussed earlier. The charts are available in Appendix III and table 8 below shows a summary of the proportion of daily drinkers by region. In terms of frequency of drinking, the North region is actually second lowest.

Table 8: Summary of the proportion of daily drinkers by region

	Average 1975 - 2007 (%)	Minimum 1975 - 2007 (%)	Maximum 1975 - 2007 (%)
<b>The North</b>	<b>9.46</b>	<b>6.89</b>	<b>12.61</b>
Greater London	13.94	11.45	17.31
South East and East Anglia	13.26	9.36	16.46
South West	13.14	8.20	17.37
East and West Midlands	11.88	9.33	16.32
Yorkshire and Humberside	11.38	8.39	15.07
North West	11.27	8.71	15.26
Scotland	7.47	4.96	11.40
Wales	10.09	6.99	13.27

- 6.3 However, the frequency of consumption data does not give any indication on the amount of alcohol drunk. So we compare the North region with the entire population in terms of heavy draught lager drinkers. The results are shown in figure 20. This suggests that although the North has the lowest proportion of daily drinkers, it has a higher proportion of 'heavy' lager drinkers than the whole population. This may suggest that people in the North drink less frequently but in larger amounts. Table 9 shows a summary of the proportion of heavy lager drinkers in the North compared with the other regions. This shows that, despite the fact that the North had the lowest proportion of daily drinkers on average; it actually has the highest proportion of heavy lager drinkers.

Figure 20: Proportion of heavy lager drinkers in the North and the whole population, 1984 to 2007

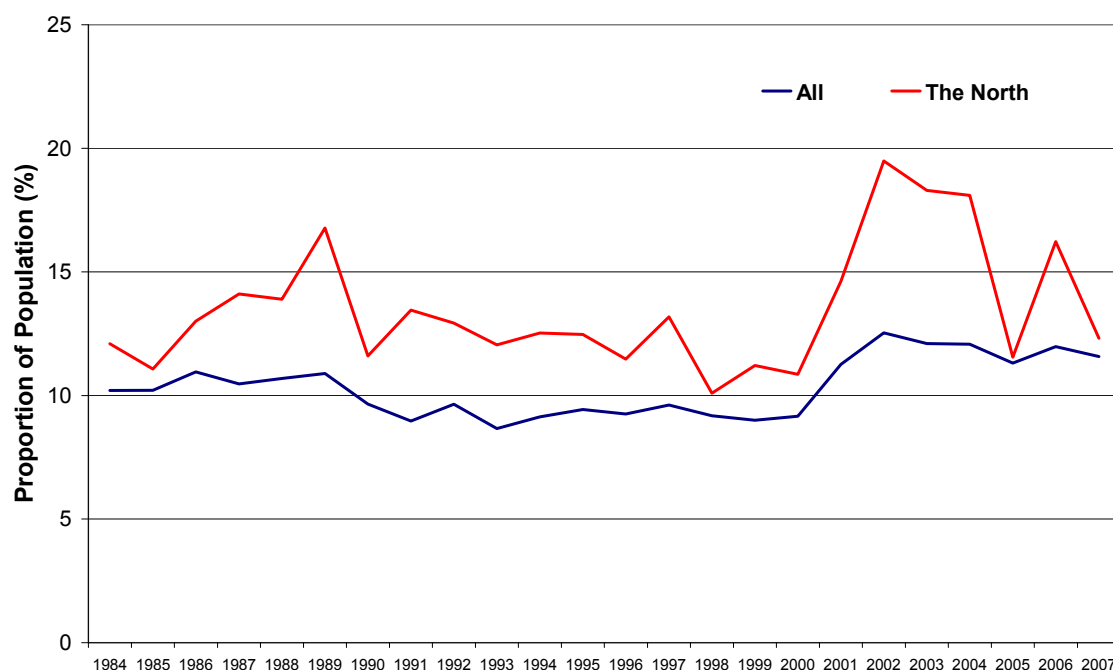


Table 9: Summary of the proportion of heavy lager drinkers by region

	Average 1975 - 2007 (%)	Minimum 1975 - 2007 (%)	Maximum 1975 - 2007 (%)
<b>The North</b>	<b>13.48</b>	<b>10.10</b>	<b>19.49</b>
Greater London	9.69	6.82	12.58
South East and East Anglia	7.96	6.47	9.91
South West	7.88	5.30	13.05
East and West Midlands	10.99	7.22	13.83
Yorkshire and Humberside	11.93	8.57	16.97
North West	11.23	8.40	15.42
Scotland	12.02	7.74	17.80
Wales	11.97	7.67	19.29

## 7. Conclusion

- 7.1 The analysis of the extended TGI series has shown that average alcohol consumption has been rising over the past few years with wine consumption showing the fastest rise and beer consumption staying flat. We find a strong positive relationship between average alcohol consumption and the proportion of high frequency drinkers at the national level.
- 7.2 However, when the TGI data is broken down by drink type, there is no relationship between average alcohol consumption by drink type and the proportion of heavy drinkers except for wine and some categories of spirit. These findings mirror Tuck and Duffy's conclusion that there is a lack of consistency by sub-group. This suggests, therefore, that a "one size fits all" policy to reduce overall consumption does not apply.

# APPENDICES

## Appendix A: Normality tests

		Test Statistic	P-Value
<b>Average Alcohol Consumption</b>		3.160	0.001
<b>All Adults</b>	Drinkers	-1.209	0.887
	Daily drinkers	2.104	0.018
	2 - 3 times a week	1.204	0.114
	Once a week	2.472	0.007
	Less than once a week	1.853	0.032
	Never	-0.893	0.814
	Average frequency in days	1.400	0.081
<b>Male</b>	Drinkers	-0.541	0.706
	Daily drinkers	-0.547	0.708
	2 - 3 times a week	-0.433	0.667
	Once a week	1.909	0.028
	Less than once a week	1.464	0.072
	Never	-1.501	0.933
	Average frequency in days	0.371	0.356
<b>Female</b>	Drinkers	-0.987	0.838
	Daily drinkers	1.131	0.129
	2 - 3 times a week	2.303	0.011
	Once a week	2.549	0.005
	Less than once a week	1.854	0.032
	Never	-0.959	0.831
	Average frequency in days	1.439	0.075
<b>Young male</b>	Drinkers	4.098	0.000
	Daily drinkers	1.744	0.041
	2 - 3 times a week	1.821	0.034
	Once a week	0.272	0.393
	Less than once a week	1.242	0.107
	Never	-0.573	0.717
	Average frequency in days	1.901	0.029
<b>Young female</b>	Drinkers	4.493	0.000
	Daily drinkers	2.545	0.005
	2 - 3 times a week	4.088	0.000
	Once a week	1.249	0.106
	Less than once a week	-1.103	0.865
	Never	0.624	0.266
	Average frequency in days	1.579	0.057

## Appendix B: Regional charts

Figure 21: The North, 1975 to 1987

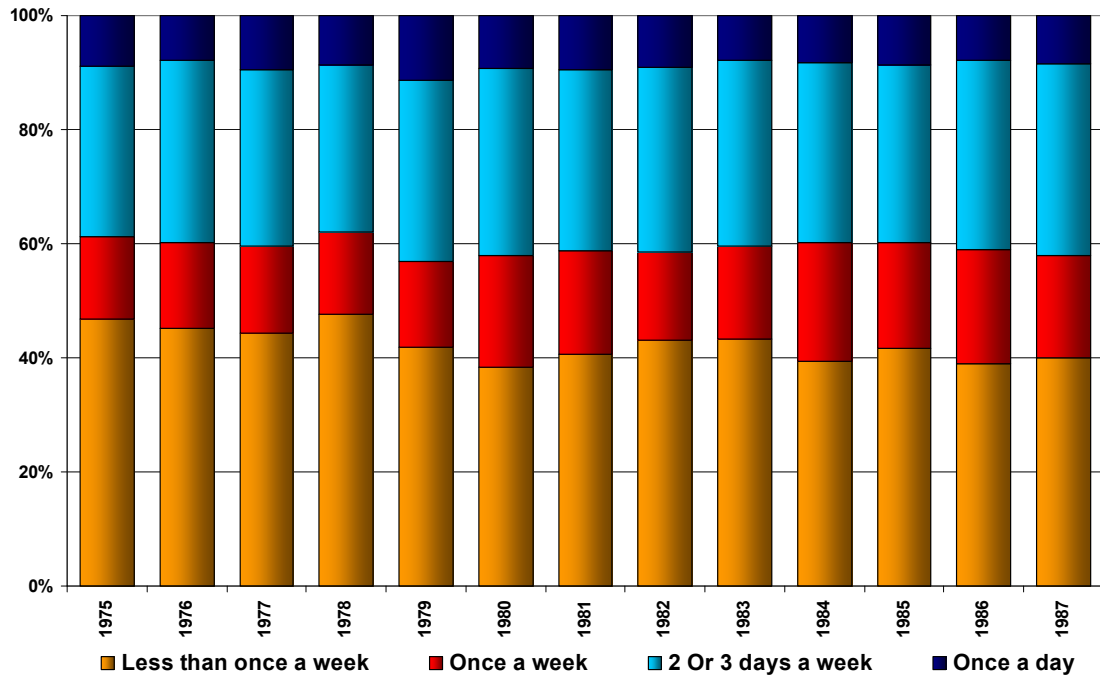


Figure 22: The North, 1988 to 2007

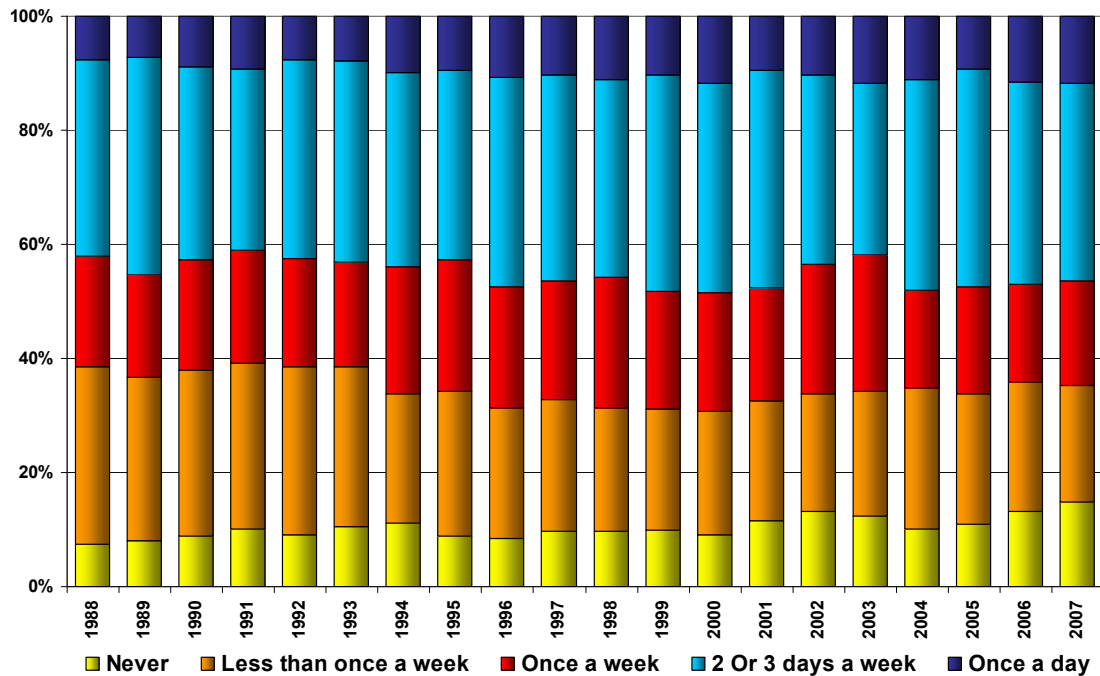


Figure 23: Greater London, 1975 to 1987

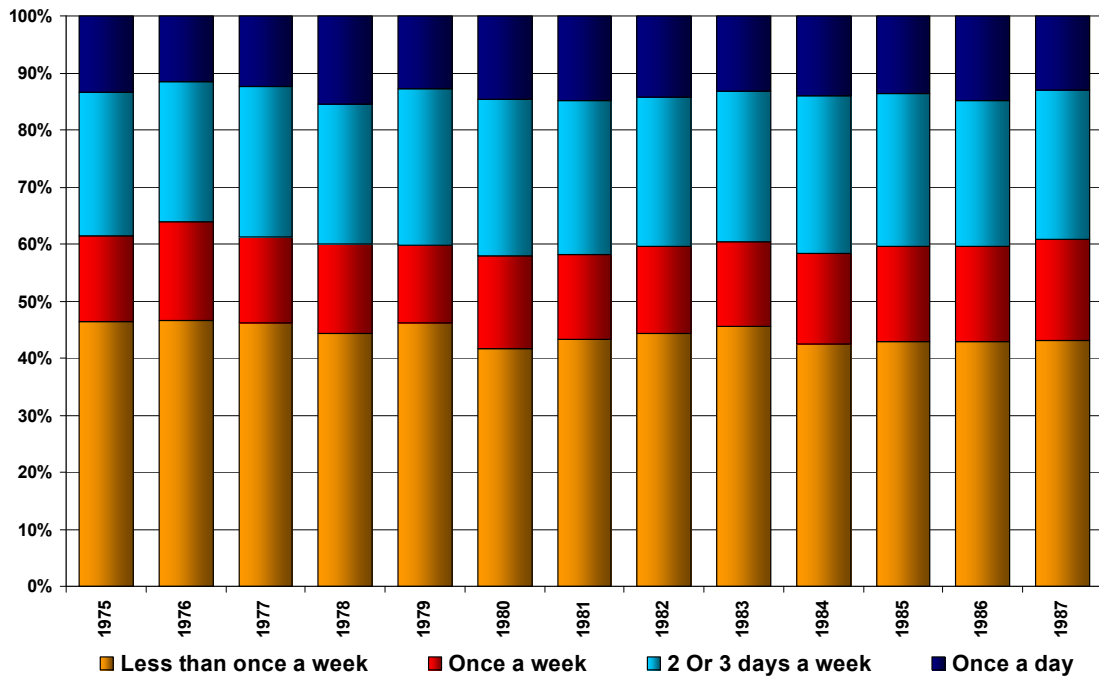


Figure 24: Greater London, 1988 to 2007

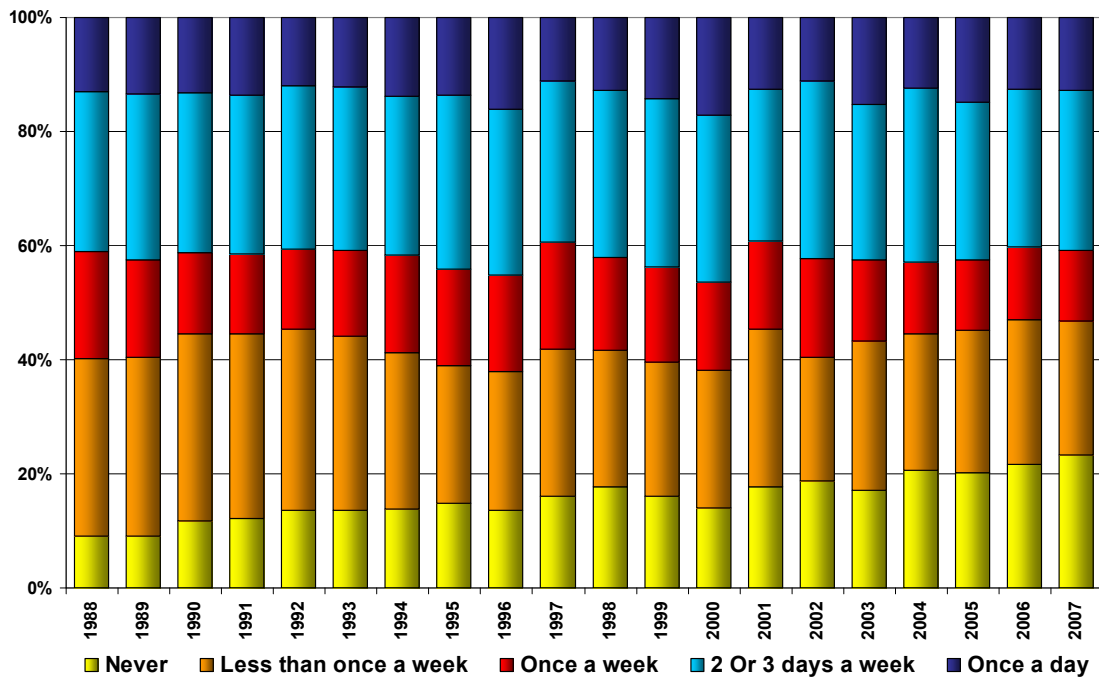


Figure 25: South East and East Anglia, 1975 to 1987

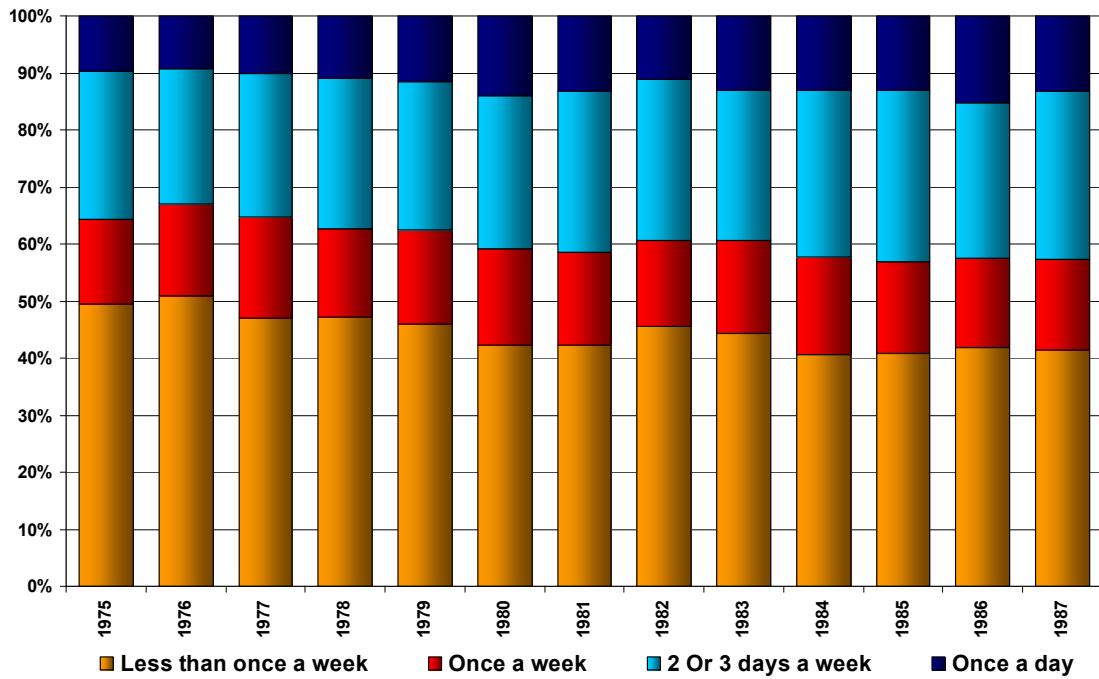


Figure 26: South East and East Anglia, 1988 to 2007

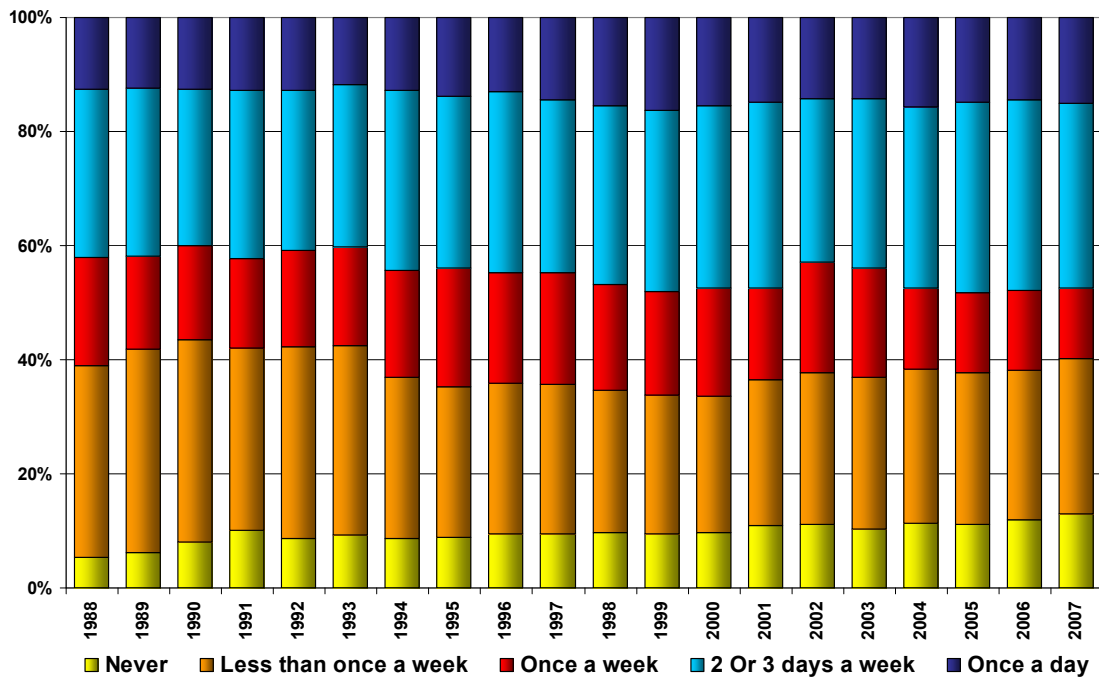


Figure 27: South West, 1975 to 1987

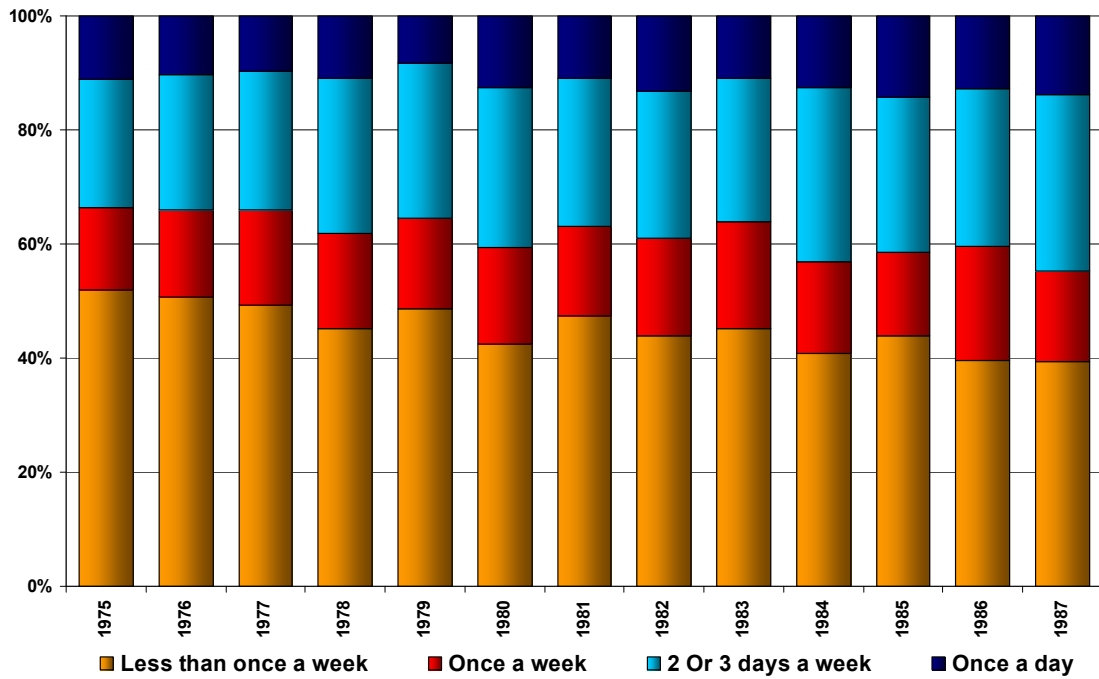


Figure 28: South West, 1988 to 2007

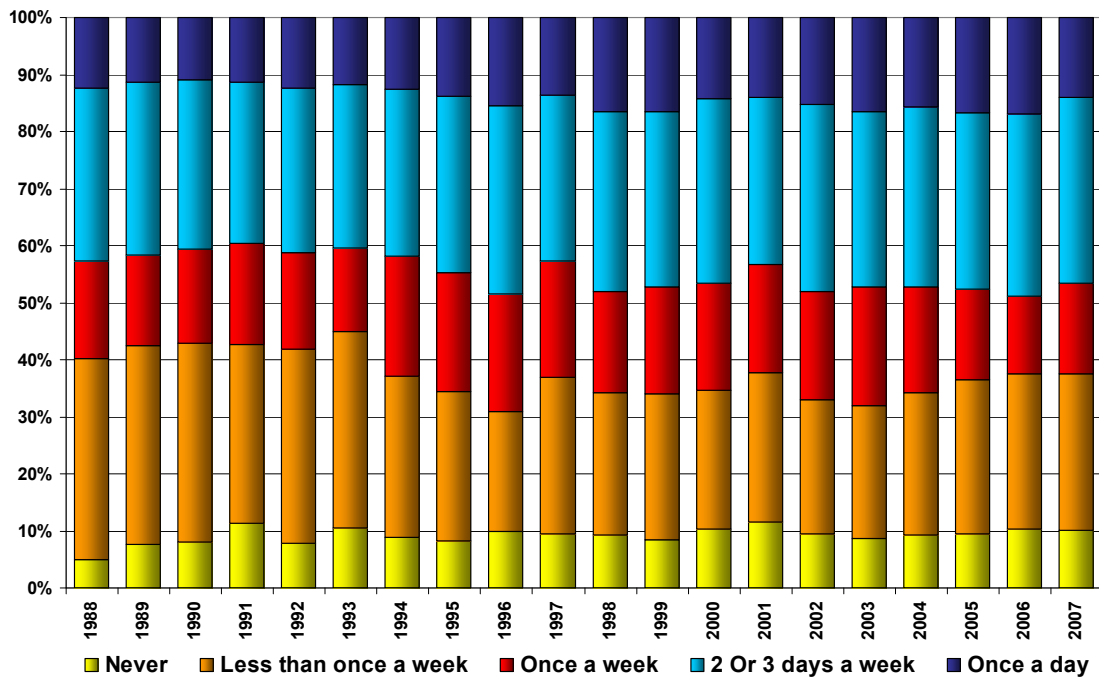


Figure 29: East and West Midlands, 1975 to 1987

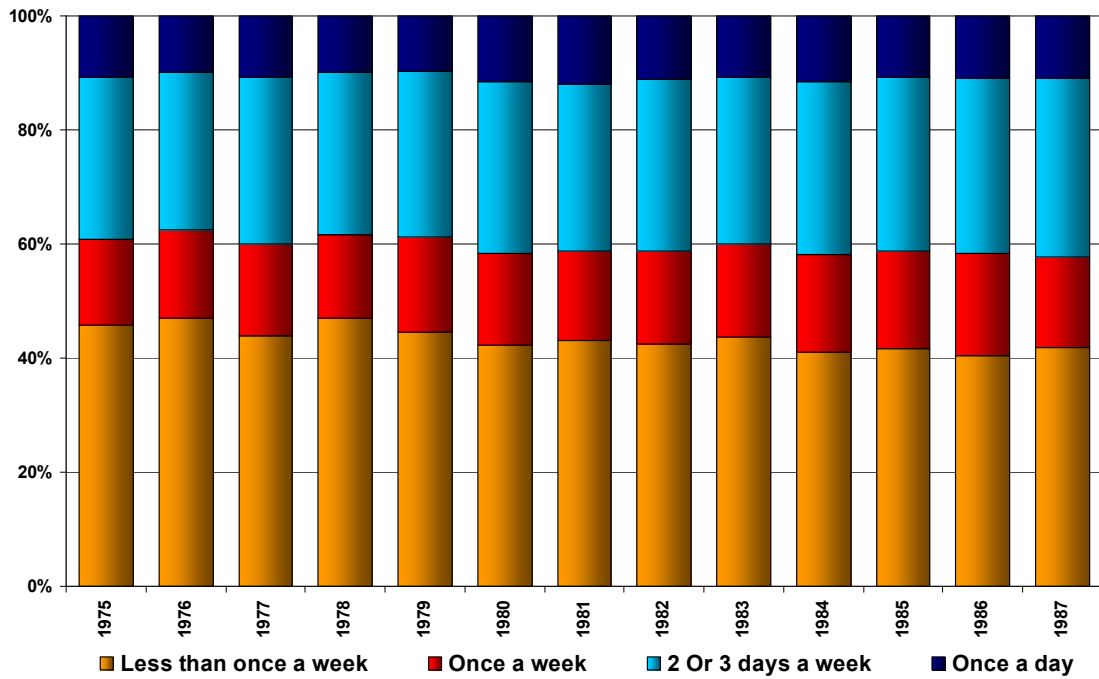


Figure 30: East and West Midlands, 1988 to 2007

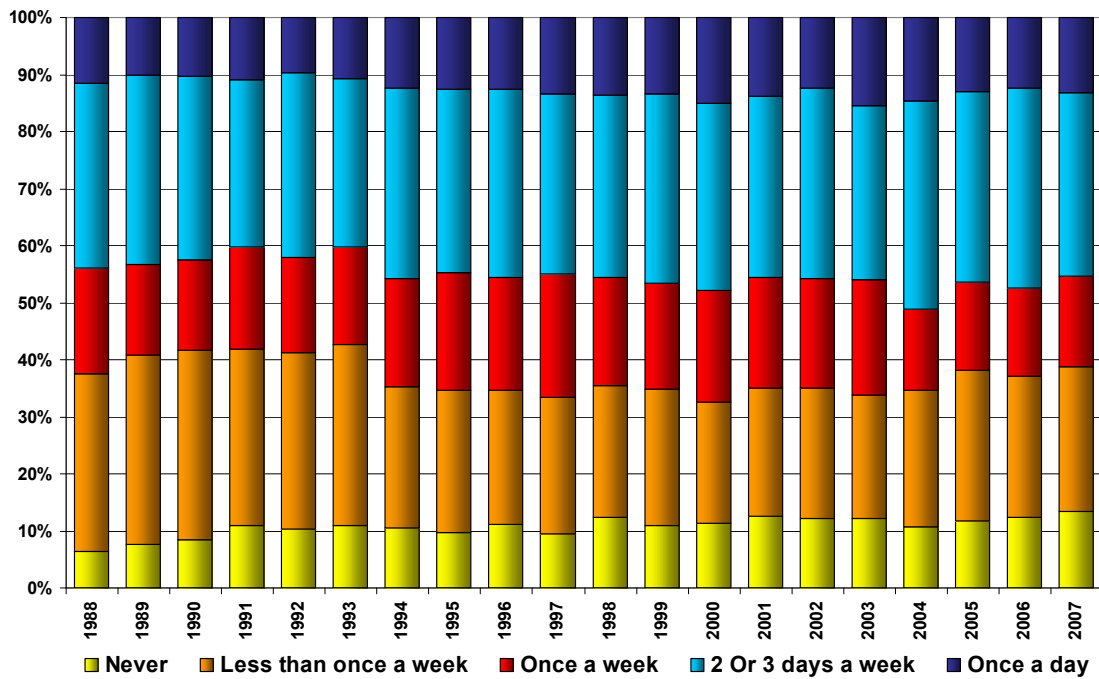


Figure 31: Yorkshire and Humberside, 1975 to 1987

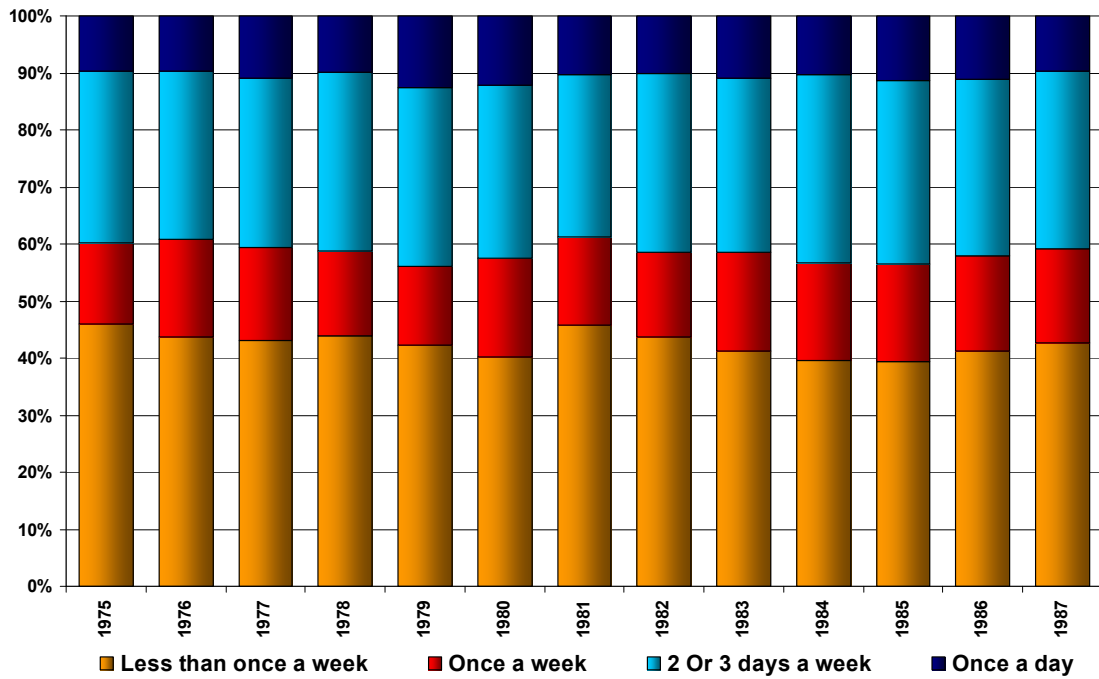


Figure 32: Yorkshire and Humberside, 1988 to 2007

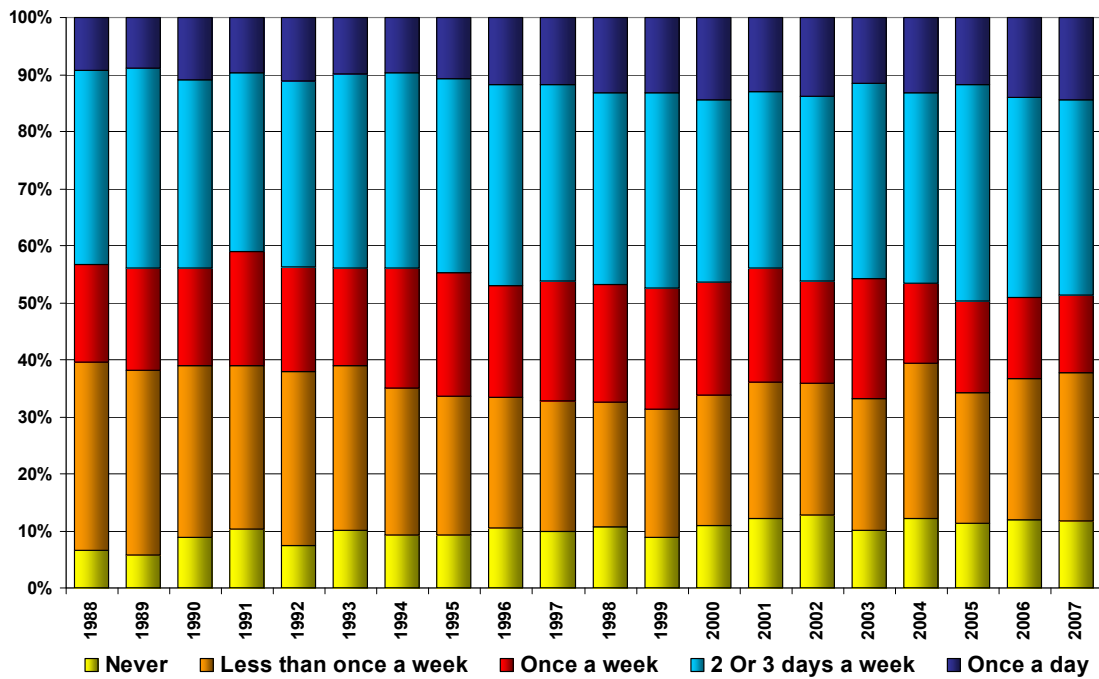


Figure 33: North West, 1975 to 1987

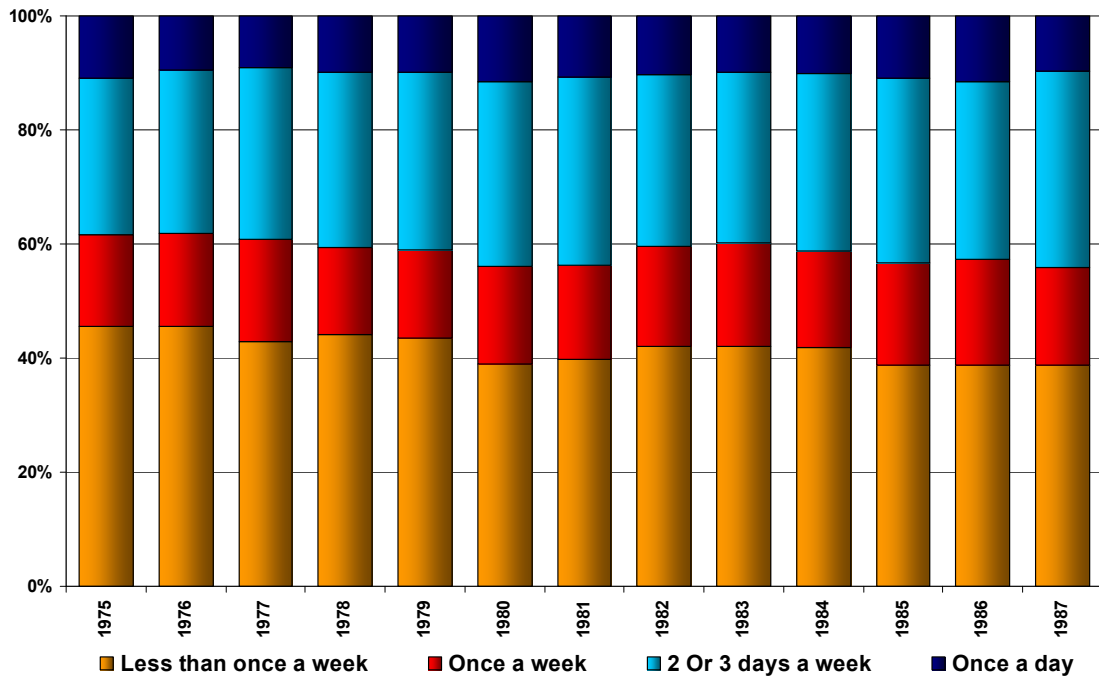


Figure 34: North West, 1988 to 2007

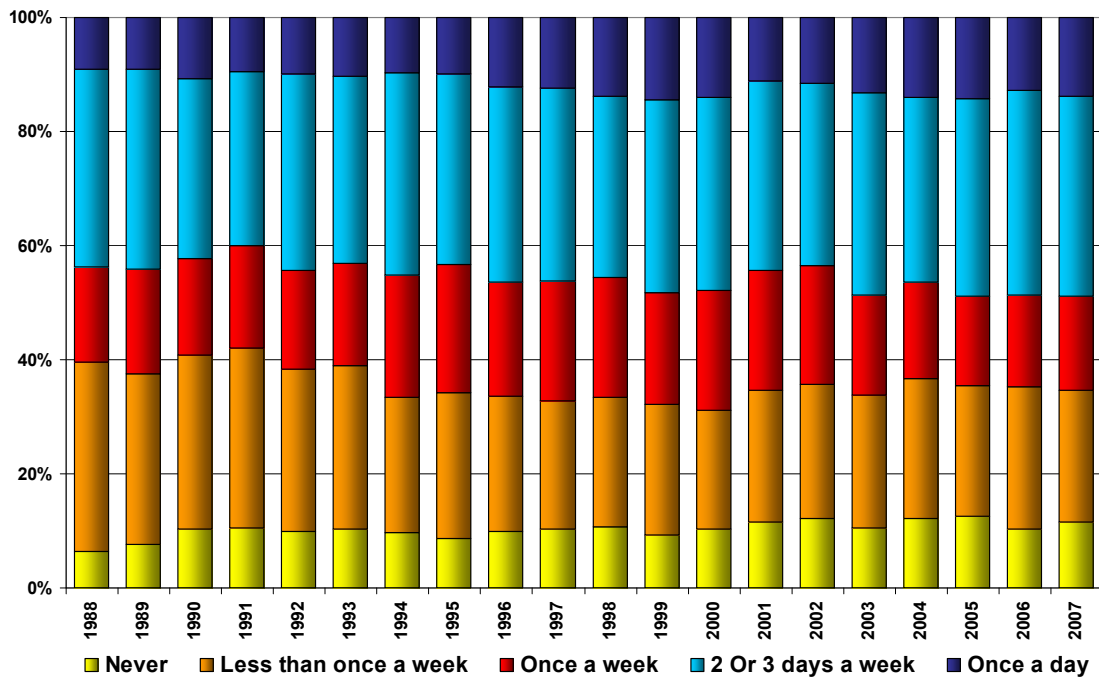


Figure 35: Scotland, 1975 to 1987

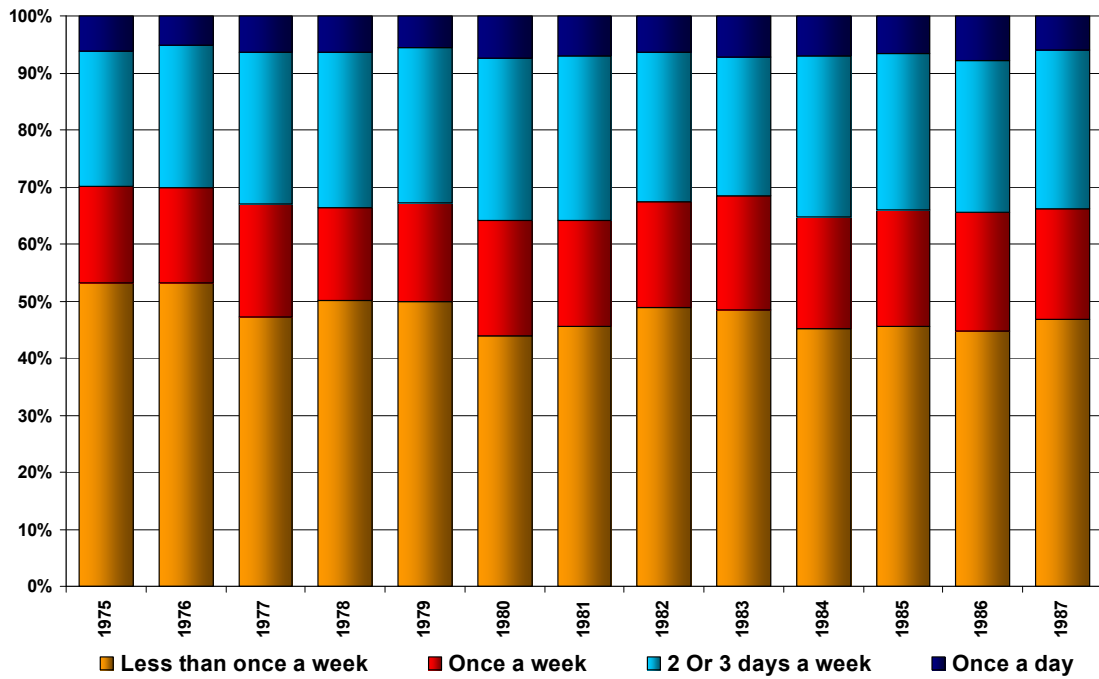


Figure 36: Scotland, 1988 to 2007

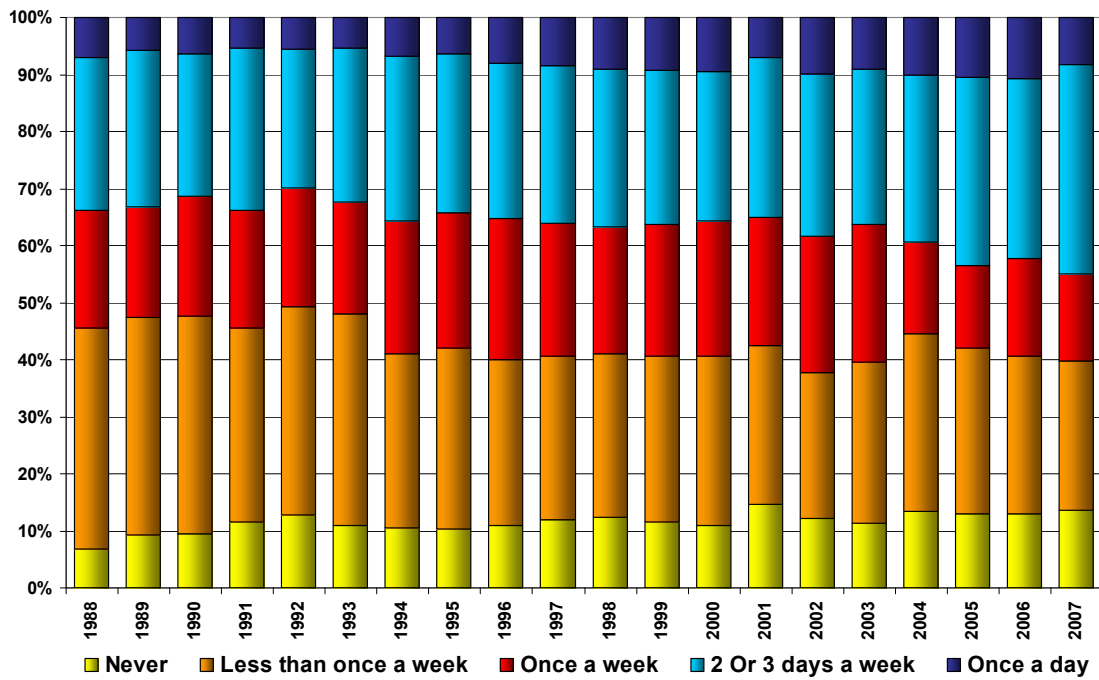


Figure 37: Scotland, 1975 to 1987

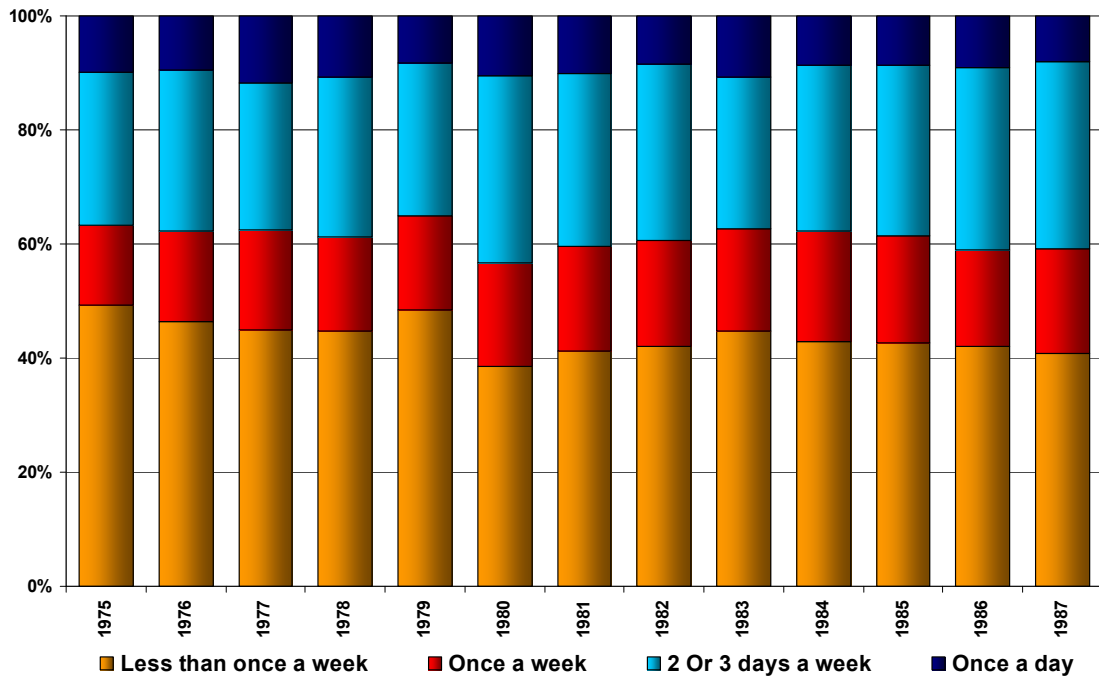
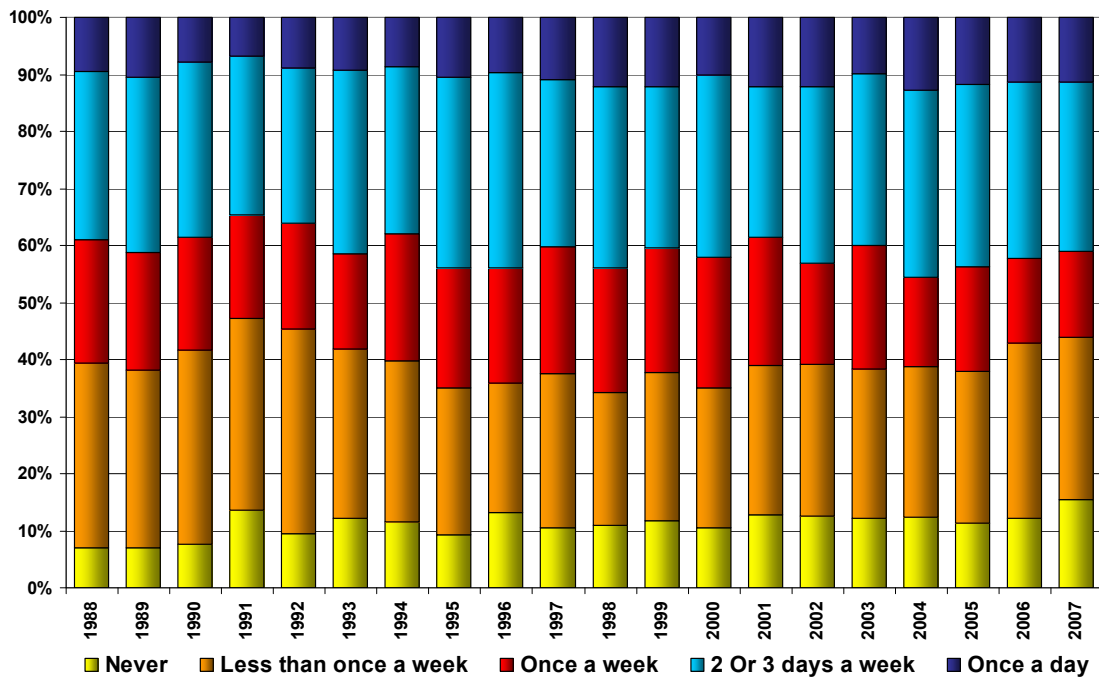


Figure 38: Scotland, 1988 to 2007



## **SECTION 3**

### **The importance of social networks in problem drinking**

## 1. Introduction

- 1.1 Volterra Consulting and FDS International were commissioned to carry out new research to see if social network effects exist in the spread of binge drinking in the UK. The focus of this pilot study is to examine the question:

*“Can the emergence of widespread anti-social binge drinking amongst young people be accounted for simply by social network effects?”*

- 1.2 In other words, is the rise of binge drinking a ‘fashion’ phenomenon, which has spread by observing and copying what other people do?
- 1.3 Binge drinking and its anti-social effects have become a matter of serious concern in the UK. There has clearly been a rapid rise in such behaviour over the past few years. While there have always been a very small minority of young people who have indulged in this sort of behaviour, it has become much more widespread. Anti-social behaviour arising through binge drinking is now a regular feature of the centres of what are normally regarded as ‘respectable’ towns.
- 1.4 There are many possible explanations for this increase. In this study, we examine the role of ‘fashion’. By this we mean the spread of behaviour through imitating and copying what others are doing. This is a long standing and important feature of many consumer markets such as popular music and films, as well as traditional fashion markets such as clothing but as the literature review in Section 1 shows, it has not been explored as an influence on alcohol consumption.
- 1.5 A key motivation for the study was an important article on the spread of obesity in America, published in 2007 in the *New England Journal of Medicine*, one of the world’s leading medical journals<sup>8</sup>. This analysis was conducted using data on 12,000 people who were monitored from 1971 to 2003.
- 1.6 The study found that social influences on behaviour in this area were very powerful. For example, the chance of any individual being obese increased by 57 per cent if he or she had a friend who became obese. Intuitively this makes sense. For example, in everyday terms, if someone is, say, 50 pounds overweight, he or she will feel obese if all of his/her friends are slim, but may even feel slender if the friends are all 100 pounds overweight. The paper in the *New England Journal* proved that ‘fashion’, the influence of other people on an individual’s behaviour, is a crucial factor in the spread of obesity in the US.
- 1.7 Many traditional econometric studies which analyse alcohol consumption over time, have been conducted in order to attempt to relate its movements to factors such as disposable income, price and advertising. None of these take into account the possible effect of copying the behaviour of others i.e. of fashion, as an important causal factor.

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<sup>8</sup> NA Christakis and JH Fowler, ‘*The Spread of Obesity in a Large Social Network over 32 Years*’, *NEJM*, 357, 2007

## 2 The data

### Definitions

- 2.1 Definitions of heavy drinking vary widely<sup>9</sup> and changes to the standard definitions can have a significant impact on the reported incidence of alcohol misuse. For example, the latest Office for National Statistics report on alcohol consumption in the UK<sup>10</sup> introduced a revised methodology for estimating the proportions of heavy drinkers within the population, taking into account increased alcohol strengths and larger drink sizes. This results in increased counts of heavy drinkers in all age and gender categories, even though the underlying data have not changed. For people aged 16-24, for example, the proportion of women identified as heavy drinkers rises from 29% to 40%.
- 2.2 The focus of this study is not on heavy drinking as such, but on drinking behaviour which is likely to lead to anti-social behaviour i.e. binge drinking.
- 2.3 An individual might regularly drink a fairly large quantity of alcohol but (being habituated) might not subjectively experience this as 'bingeing', i.e. might not actually feel that they are particularly drunk. Thus, in order to distinguish between *binge* drinkers and those who are simply regular *heavy* drinkers, our definition is based upon a combination of consumption of alcohol (anyone drinking more than 10 drinks in a single session is considered to be drinking enough to get very drunk, regardless of their own perception), and subjective perception – those who at least once a week drink an amount that they had previously specified as being, for them, as being "enough to get very drunk".
- 2.4 We have therefore defined 'binge drinking' for the purposes of the pilot study as follows:-
- For men, getting drunk on 4 or more drinks OR having 10 or more drinks (but not necessarily getting drunk) at least once a week and for women, getting drunk on 3 or more drinks OR having 10 or more drinks (but not necessarily getting drunk) at least once a week.
- 2.5 This definition therefore captures behaviour that is directed at purposefully getting drunk, and also includes those who drink excessively (i.e. ten or more drinks in a single session) even if the excessive drinking does not cause the drinker to feel drunk.

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<sup>9</sup> As described, for example, in *Practical Guides for Alcohol Policy and Prevention Approaches*, International Centre for Alcohol Policies, 2005

<sup>10</sup> *Drinking: adults' behaviour and knowledge in 2007*, Office of National Statistics, 2008

## Primary Research

- 2.6 The quantitative research conducted for the pilot study consisted of interviews with 504 18-24 year-olds in the UK using an online survey based on MyVoice Panel. Of the respondents, 258 (51%) were male and 246 (49%) were female. The interviews were carried out between 20th February and 28th February 2008.
- 2.7 For the purposes of the pilot study, the sample group was selected to reflect a demographic which is believed to represent a particular problem in terms of alcohol consumption. The survey asked about the number of drinks consumed. In order to translate the survey responses based on the number of 'drinks' into data related to units of consumption, we have assumed that on average a 'drink' represents two alcohol units<sup>11</sup>.

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<sup>11</sup> Appendix II contains information on alcohol units per drink type from the Office of National Statistics and describes how the average of 2 units per drink was calculated. This Appendix also compares the definition of binge drinking used here with the current ONS definition of 'heavy' drinking.

### 3 Characteristics of Binge Drinkers

#### How many are there?

- 3.1 Overall, 16.2% of respondents qualified as binge drinkers using the definition described above. This proportion is derived from the average of the binge drinking sub-group amongst men (of whom 17% qualified as binge drinkers) and women (of whom 15% were binge drinkers). Of this group, the vast majority reported anti-social behaviour as a result of binge drinking such as shouting or vomiting in the street and getting into a fight.
- 3.2 Scaling up the survey, the figures indicate there are around 950,000 binge drinkers in the UK 18-24 year old population, participating in nearly 1.5 million binge drinking 'events' each week.

#### Demographic Profile

- 3.3 Binge drinkers are only slightly more likely to be male than female (55% vs. 45%), while their age profile, although fairly evenly distributed across ages 18-24, suggests that binge-drinking may peak at around age 21.
- 3.4 Binge drinkers are over-represented among young people with low educational qualifications *and* among those with degrees – but significantly less likely to be found among those with postgraduate or 'other' (generally vocational) qualifications.
- 3.5 Perhaps surprisingly, the survey found no apparent relationship between being a parent and binge drinking - but binge-drinkers *are* significantly less likely to be married or cohabiting.

## Binge Drinkers' Attitudes to Drinking and Motivations for Drinking

- 3.6 Clearly in many instances, binge drinking is a fairly deliberate act, which binge-drinking respondents are happy to admit to setting out to do. When asked about types of drinking occasions which are enjoyed, binge drinkers were no more likely than other drinkers to say they enjoy drinking to relax after a hard day, or drinking with a meal – indeed they are less likely to report enjoying drinking on their own (clearly the link between binge drinking and sociability is a key motivator, as we will also see later). However, huge differences emerge when it comes to enjoying “a big night out with a lot of drinking” and (even more so) enjoying “Going out to get drunk”.
- 3.7 However, on any given drinking night, well over a third of binge drinkers only intended to drink ‘one or two drinks’, or not to drink at all. So while many binge drinking occasions appear to be pre-meditated, it is equally clear that many binges are not so.
- 3.8 Furthermore, there is a clear relationship between binge drinking and reporting of *increasing alcohol consumption* over the past two years – well over half of all binge drinkers report that they are drinking more by comparison with two years ago. This may relate to the fact that many young adults in the age groups we studied are still inexperienced drinkers, who are still establishing socialising and drinking habits.

## Negative Consequences of Binge Drinking

- 3.9 Binge drinkers suffer a wide range of negative consequences as a result of binge drinking, and the prevalence of experiencing negative consequences from drinking is hugely greater among binge drinkers than among other young adults.
- 3.10 Some of the most *common* negative effects of drinking are ‘memory loss’ and ‘shouting or singing in the street’ (experienced by three-quarters and two-thirds of binge drinkers respectively).
- 3.11 The negative drink-related experiences and behaviours which are *relatively* most likely to be suffered by binge drinkers (and those around them), by comparison with other young adults are: vandalism (almost three times more likely to be ‘experienced’ by binge drinkers), getting into financial difficulties (binge drinkers more than twice as likely to have suffered this), while getting into fights and getting arrested are also twice as common among young binge drinkers. Negative consequences for work and school (and for the economy as a whole) are also very apparent, with 57% of binge drinkers missing work or school due to drinking, by comparison with 32% of all 18-24s.
- 3.12 It is also evident that binge drinking helps to stimulate social contact for binge drinkers – with binge drinkers significantly more likely to say they have ‘made new friends’ and ‘chatted someone up’ as a result of drinking.
- 3.13 As a result of this analysis however, we are confident that the binge drinkers defined in our primary research (16.2% of 18-24 year olds), are taking part in anti-social behaviour leading from misuse of alcohol.

## 4 Social influences on binge drinkers

- 4.1 Social networks are much more pervasive than the social networking sites which are currently the feature of so much attention. Such sites are only a tiny fraction of the social networks which exist. Every person is involved in a range of social networks, such as family, work colleagues, friends, hobby groups and so on.
- 4.2 Individual decisions on brands, products, lifestyle, behaviour and so on is affected not just by 'objective' attributes (eg. price and quality) or by an individual's circumstances (eg. how much money they have to spend) but also by the influence of the decisions taken by other people. To varying degrees, people imitate what other people do, 'fashion' is important.
- 4.3 In this analysis, we looked at the patterns of social interaction for those classified as binge drinkers and compared them to the patterns of non-binge drinkers. We looked at three types of social group which might have an influence on a person's drinking behaviour:-
- Family
  - Work colleagues
  - Friends

### Importance of social influences on behaviour

- 4.4 Everyone in the survey was asked what they thought about the binge drinking behaviour of people in their social groups. Table 1 shows the results for family members.

Table 1: Proportion of family thought to be binge drinkers: for binge drinkers and non-binge drinkers

Proportion of family thought to be binge drinkers	Proportion (%) for binge drinkers	Proportion (%) for non-binge drinkers
All of them	9	3
Almost all of them	9	3
Most of them	11	10
Some of them	33	28
Hardly any of them	29	36
None of them	10	19

In the survey, specific numbers were not allocated to the categories, and the respondents themselves chose which answer most applied to them. The use of this semantic scale is a standard survey technique.

- 4.5 So, for example, amongst people who binge drink themselves, 29 per cent think that 'all', 'almost all' or 'most' their family members also binge drink. This compares to non-binge drinkers, 16 per cent of which think the same categories of their family members binge drink.

- 4.6 The data show there are differences in the perceived behaviour of the family members of binge and non-binge drinkers, although the differences are not dramatic.
- 4.7 These differences are considerably more marked when the behaviour of work colleagues is examined.

*Table 2: Proportion of colleagues thought to be binge drinkers: for binge drinkers and non-binge drinkers*

<b>Proportion of colleagues thought to be binge drinkers</b>	<b>Proportion (%) for binge drinkers</b>	<b>Proportion (%) for non-binge drinkers</b>
All of them	13	2
Almost all of them	21	10
Most of them	31	22
Some of them	24	42
Hardly any of them	7	18
None of them	6	6

- 4.8 Here, for example, no less than 65 per cent of binge drinkers think that ‘all’, ‘almost all’ or ‘most’ of their work colleagues binge drink, compared to only 34 per cent of non-binge drinkers.
- 4.9 But the most dramatic difference is seen in the behaviour of friends<sup>12</sup>.

*Table 3: Proportion of friends thought to be binge drinkers: for binge drinkers and non-binge drinkers*

<b>Proportion of friends thought to be binge drinkers</b>	<b>Proportion (%) for binge drinkers</b>	<b>Proportion (%) for non-binge drinkers</b>
All of them	24	6
Almost all of them	30	11
Most of them	31	24
Some of them	12	36
Hardly any of them	1	15
None of them	2	7

- 4.10 Table 3 shows that 85% of binge drinkers think that all, almost all or most of their friends are binge drinkers, compared to just 41% of non-binge drinkers for whom all or almost all friends are binge drinkers. Conversely, only 3% of binge drinkers have no or hardly any friends that binge drink, compared to 22% of non-binge drinkers.

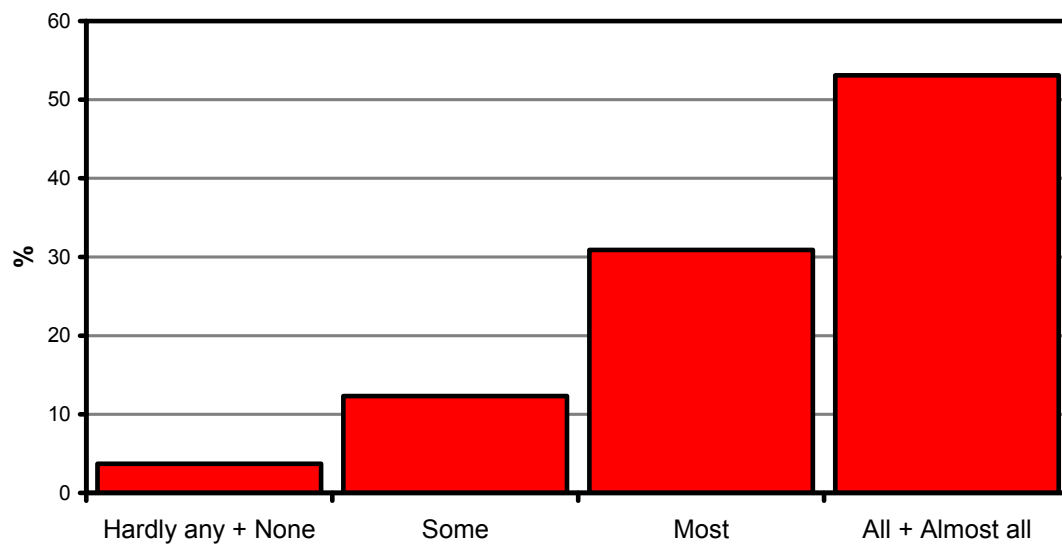
<sup>12</sup> This is confirmed in formal analysis by calculating both the Manhattan and Euclidean norms between the two columns

4.11 We can simplify these classifications as follows and plot them in charts. We grouped the social influence data into four categories<sup>13</sup>, comprising:-

1. Hardly Any + None
2. Some of them
3. Most of them
4. All + Almost All

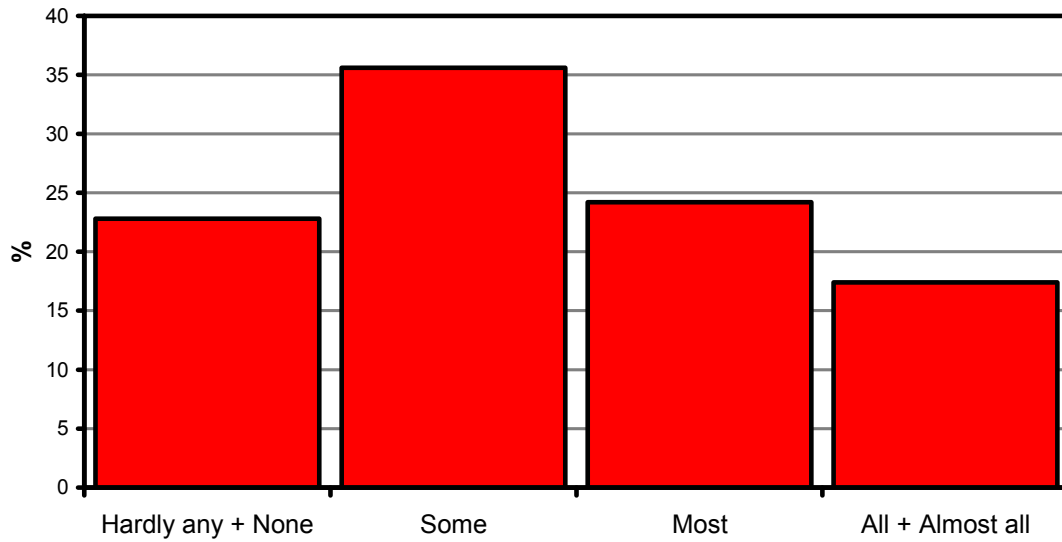
4.12 Using these categories, Figures 1 and 2 below show the significant difference in proportions of binge drinkers' friends thought to be binge drinkers compared to those who do not qualify as binge drinkers.

Figure 39: Proportion of binge drinker's friends who are thought to be binge drinkers



<sup>13</sup> The percentages used for these ranges are described in the Appendix

Figure 40: Proportion of non-binge drinker's friends who are thought to be binge drinkers



4.13 Figures 39 and 40 show that in all binge drinkers are more likely to have a higher proportion of relationships with other binge drinkers than the non-binge drinkers. This suggests that social interaction is related to the spread of binge drinking.

## Explaining the findings

### Overview

- 4.14 Figures 1 and 2 show the dramatic difference between the drinking behaviour of the friends of those who are binge drinkers themselves and those who are not.
- 4.15 One possible way to analyse the effect of imitation on drinking behaviour would be to try to gather complete information on the friendship networks of the people in the survey, and to map the network in its entirety.
- 4.16 However, this approach has really only to be stated to see how infeasible it would be in practice. Obtaining the exact structure of friendship networks across 500 individuals would involve a massive exercise.
- 4.17 Instead, in most practical situations where individuals might be influenced by the behaviour of others, we need to make simplifications and approximations to the relevant social networks. One way of thinking of this is as follows. The best possible map of an area is one which is literally as big as the area itself. It captures all possible features. But it would be wholly impracticable to use. Instead, good maps extract the key features of an area, and focus on these.
- 4.18 In the same way, in most marketing and social contexts, we need to simplify the problem if we are to turn limited information – which is all we have on most social networks – into valuable knowledge.
- 4.19 The Technical Appendix sets out in detail how this is done. This itself is based on a paper prepared for a conference on social networks sponsored by the US Office for Naval Research, and published in the leading statistical physics journal, *Physica A*<sup>14</sup>.

### Methodology

- 4.20 In this pilot study, we make the assumption that the only reason why a person might become a binge drinker is through observing and imitating the behaviour of his or her friends. In practice, other factors such as the price of alcohol might also influence this choice. But we know both from Figures 1 and 2 and from the American study on obesity that the influence of friends is very important in this type of life-style choice.
- 4.21 We cannot obtain complete information on the network of friends in the survey itself, so instead we use *types* of networks which are known to be important in social contexts. There are 3 types of network for which evidence has been found in social settings (see Appendix for further details):-
- *random*: where there is no discernible pattern in connections between individuals. Such networks are important in the spread of common colds, for example.
  - *small world*: characterised by tightly clustered local groups with occasional long-range connections between groups – essentially a ‘friends of friends’ structure
  - *scale free*: characterised by a small number individuals who have many connections, who may act as key opinion/thought leaders.

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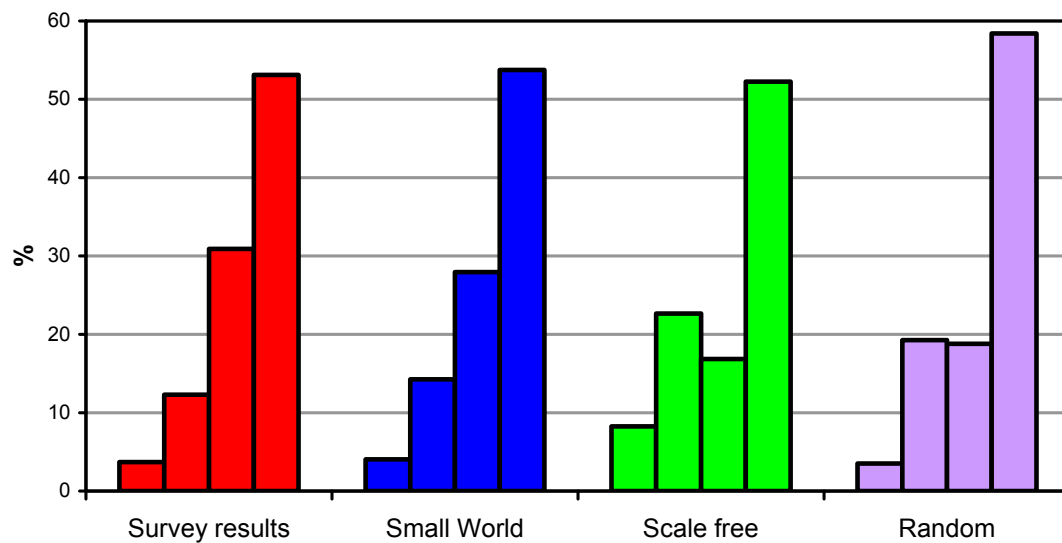
<sup>14</sup> P Ormerod, ‘Extracting Deep Knowledge from Limited Information’, *Physica A*, 378, 48-52, 2007

- 4.22 We set up a model with a large number of individuals, connected to each other on one of the above types of network. Each individual is assigned a unique 'propensity' to become a binge drinker. This means the percentage of his/her friends who are binge drinkers which are required to persuade the individual to also become a binge drinker. Some will require all or most of their friends to be binge drinkers before they change behaviour, others will be more easily persuaded.
- 4.23 Again, it would be a formidable, if not impossible, task to obtain this exact information from everyone in the survey. So we assume there is a range of 'persuadability' amongst individuals.
- 4.24 We start solving the model in a situation in which no-one is a binge drinker. A small number of people in the model are selected at random to become binge drinkers. Then we see how far their influence spreads, and how many people are persuaded by social influences to become binge drinkers themselves.
- 4.25 We know from the survey that 16.2 per cent of the sample are binge drinkers, so when the percentage in the model reaches this number, we examine the friendship networks in the theoretical model and see if they match the results plotted in Figures 39 and 40 above.
- 4.26 In other words, we investigate whether social influences across friendship networks are themselves sufficient to account for the patterns we observe both in the percentage of binge drinking in the youth population as a whole. We also examine, much more subtly, whether our model can replicate the distributions of binge and non-binge drinkers amongst those who become, in the model, binge drinkers. This is a difficult test for a model to pass. Many models could replicate an increase in binge drinking to 16.2 per cent, but it is much harder to get these friendship influences to match the data.
- 4.27 Finally, in order to iron out any idiosyncrasies of any individual solution of the model, we solve it many times and take averages of the solutions. This is standard practice in modelling of this kind.

## Results

- 4.28 This approach *is* able to account for the spread of binge drinking behaviour as a 'fashion' phenomenon, spread by imitating the behaviour of friends.
- 4.29 Figure 3 compares the results obtained from the survey – showing the distribution of binge drinking among friends – with the results obtained using the model for each of the three different types of network.
- 4.30 This chart shows the distribution of the friends of people who are binge drinkers themselves. In each case, the first bar shows the percentage of binge drinkers who think that 'none' or 'hardly any' of their friends are binge drinkers. The second bar shows the percentage who think the 'some' are, and the third the percentage who think 'most' are. Finally, the fourth bar in each case shows the percentage of binge drinkers who think that 'all' or 'almost all' of their friends are binge drinkers. The bars in red are the ones shown on a larger scale in Figure 1 above.

Figure 41: Model Results Against Each Type of Network



- 4.31 As the chart shows, the 'small world' network structure gives a much better explanation of the observed friendship patterns of binge drinking than the other two.
- 4.32 Given that 'small world' is essentially a 'friends of friends' network – if I am your friend there is a very good chance that I am also a friend of your other friends – this is perhaps not surprising. However, the fact that it is also intuitively plausible adds to the credibility of the approach – imitating a friend who is getting drunk is more plausible than just imitating a random stranger or even a respected acquaintance, since as it is a close friend, it is more likely that you will both benefit from the positive elements of the drunken occasion.

## 5 Conclusion

- 5.1 This pilot study is ground breaking research into the social networking effects on the misuse of alcohol. The results establish that social influence operating through personal friendship networks is sufficient by itself to explain a large rise in binge drinking amongst young people. The results clearly show that an individual is more likely to be a binge drinker if their close friends are binge drinkers too.
- 5.2 The results are also intuitively plausible. Imagine a scenario where the behaviour of your close friends was *less* important than the influence of advertising on the spread of misuse of alcohol - given the social nature of binge drinking among young people, this just is not credible – imitation of a close friend's drunken behaviour is likely as you both share the positive elements of the occasion.
- 5.3 The recent rapid growth of binge drinking also points to the importance of the behaviour of close friends as an influence, over and above the behaviour of strangers or indeed, the influence of advertising. Given that advertising has been around for many years, if this were a key factor one would have expected to see more rapid spread of the phenomenon of binge drinking years ago. A fundamental question for the view that advertising is an important determinant of the rise in binge drinking is why it has only taken place recently and not at some point in the past. There is no satisfactory answer to this point from the perspective in which advertising is important. In contrast, a fundamental feature of models in which imitation across a social network is a key determinant of behaviour, is precisely that a particular behaviour can indeed spread at any point in time
- 5.4 To put the conclusion beyond doubt, additional survey work and analysis is required to assess the *relative* importance of friendship networks and factors such as the price of alcohol. But the behaviour of close friends is clearly a very important determinant of the rise of anti-social binge drinking in the UK and policy formulation needs to develop strategies that focus on this area.

# APPENDICES

## Appendix A: Network Modelling Methodology

The aim of this appendix is to detail the methodology, results and analysis undertaken as part of the study into the impact of social networks on binge drinking behaviour. The objective of this research was to identify the network structure and rules that best reproduced the survey results for binge drinkers and their network of friends.

### Networks Included in the Analysis

Three types of networks which were studied as part of the project: small world<sup>15</sup>, scale free<sup>16</sup> and random networks.

#### Small World

In 1998 Watts and Strogatz designed the small world network to demonstrate the property of social networks where people are connected by short chains of acquaintances to other members of our society. They linked each individual to those who are geographically nearest to them. Then they 'rewired' a proportion of the connections introducing long distance links between people far apart from one another. This small world network is interesting because it combines short average chains of acquaintances between any two individuals with a low total number of links.

Small world networks are further subdivided into two classes. Firstly one where agents are assigned random links at the expense of connections to their immediate neighbours (replacement rewiring) and secondly where these random links are in addition to their existing links (additional rewiring).

#### Scale Free

The scale free network was designed to address the issue of the different numbers of people known by individuals in a social network. In society there are popular people who act as hubs with huge numbers of acquaintances and there are people with very few social contacts. For example, in the case of scientific authors there are prolific writers who continually produce paper after paper, collaborating with scientists of many fields and countries. At the other end of the scale are the much more numerous graduate students who may only ever publish one paper with very few co-authors.

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<sup>15</sup> Watts DJ, Strogatz SH, 'Collective dynamics of 'small-world' networks'. *Nature* 393:440-42 1998

<sup>16</sup> Vespignani et Al, 'Dynamical patterns of epidemic outbreaks in complex heterogeneous networks'. *Journal of Theoretical Biology*. 2005;1:1-13. 2004

## Random

Both the scale free and small world networks provide a structure for the connections between people in society, although the characteristics of this structure are very different. The random network is used as a control against the other social networks as it has no inherent structure.

## Survey Results

In the survey respondents were asked how many of their friends, family and colleagues they thought were binge drinkers<sup>17</sup>. The qualitative answers to this question were transformed into quantitative values. For example the answer of 'some' was allocated the values of greater than 25% and up to 50% of the person's network were thought to be binge drinkers. Table A.1 defines how the questionnaire responses were transformed.

Table A.1: Assigned values for the questionnaire responses.

Questionnaire Response	Assigned Value	Corresponding Value For Quartile Denoted As
'Hardly any' and 'None'	$\geq 0$ and $\leq 25\%$	$Q_1$
'Some'	$>25\%$ and $\leq 50\%$	$Q_2$
'Most'	$>50\%$ and $\leq 75\%$	$Q_3$
'All' and 'Almost all'	$>75\%$ and $\leq 100\%$	$Q_4$

The results from this section of the questionnaire are shown in Table A.2 while the results for the friends of respondents identified as being either binge drinkers or non-binge drinkers are shown in Figures A.1 and A.2 respectively.

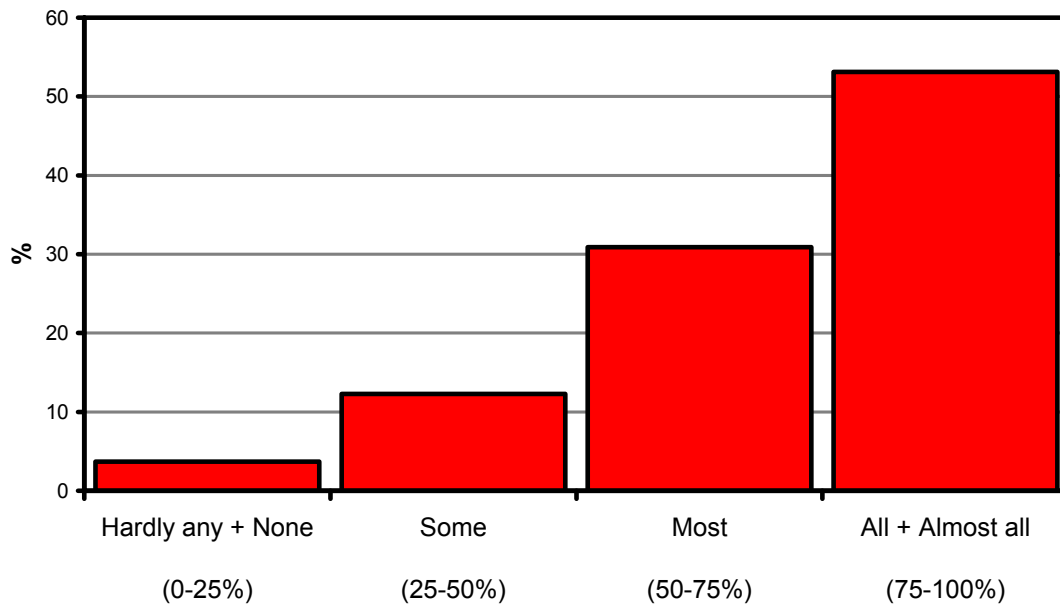
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<sup>17</sup> Defined as: for men, at least once a week getting drunk on 4 or more drinks OR having 10 or more drinks (not necessarily getting drunk) or for women, at least once a week getting drunk on 3 or more drinks OR having 10 or more drinks (not necessarily getting drunk).

Table A.2: Summary of the responses to questions QD9i-QD9iii of the survey<sup>18</sup>

	Family		Friends		Colleagues	
	Non-binge drinkers	Binge drinkers	Non-binge drinkers	Binge drinkers	Non-binge drinkers	Binge drinkers
Q <sub>1</sub>	55%	39%	22.8%	3.7%	24%	13%
Q <sub>2</sub>	28%	33%	35.6%	12.3%	42%	24%
Q <sub>3</sub>	10%	11%	24.2%	30.9%	22%	31%
Q <sub>4</sub>	6%	18%	17.4%	53.1%	12%	34%

Figure A.1: Questionnaire results for the proportion of the binge drinker's friends who are thought to be binge drinkers



<sup>18</sup> Note that the survey results for the friends of binge drinkers were given parameter names which are used in the remainder of this appendix.

Figure A.2: Questionnaire results for the proportion of the non-binge drinker's friends who are thought to be binge drinkers

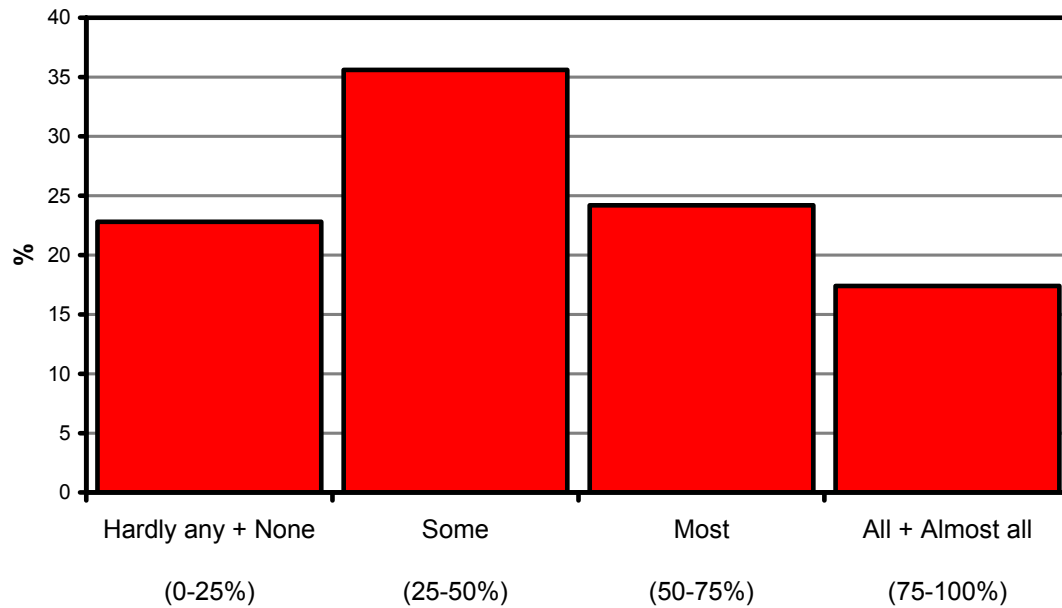


Table A.2 shows that in all three networks binge drinkers are more likely to have a higher proportion of relationships with other binge drinkers than the non-binge drinkers. This suggests that social interaction is related to the spread of binge drinking.

### Methodology

Figure A.3 outlines the systematic approach taken to identify the final candidate models while Table A.3 describes the parameters used in the program as well as their value or the range values studied. It is important to ensure that the range of parameters used for the various networks produces systems with comparable number of links or levels of connectivity. Therefore it is necessary to calculate the number of links in each network. Table A.4 defines the equations used to compare the degree of connectivity between network types and parameterisations.

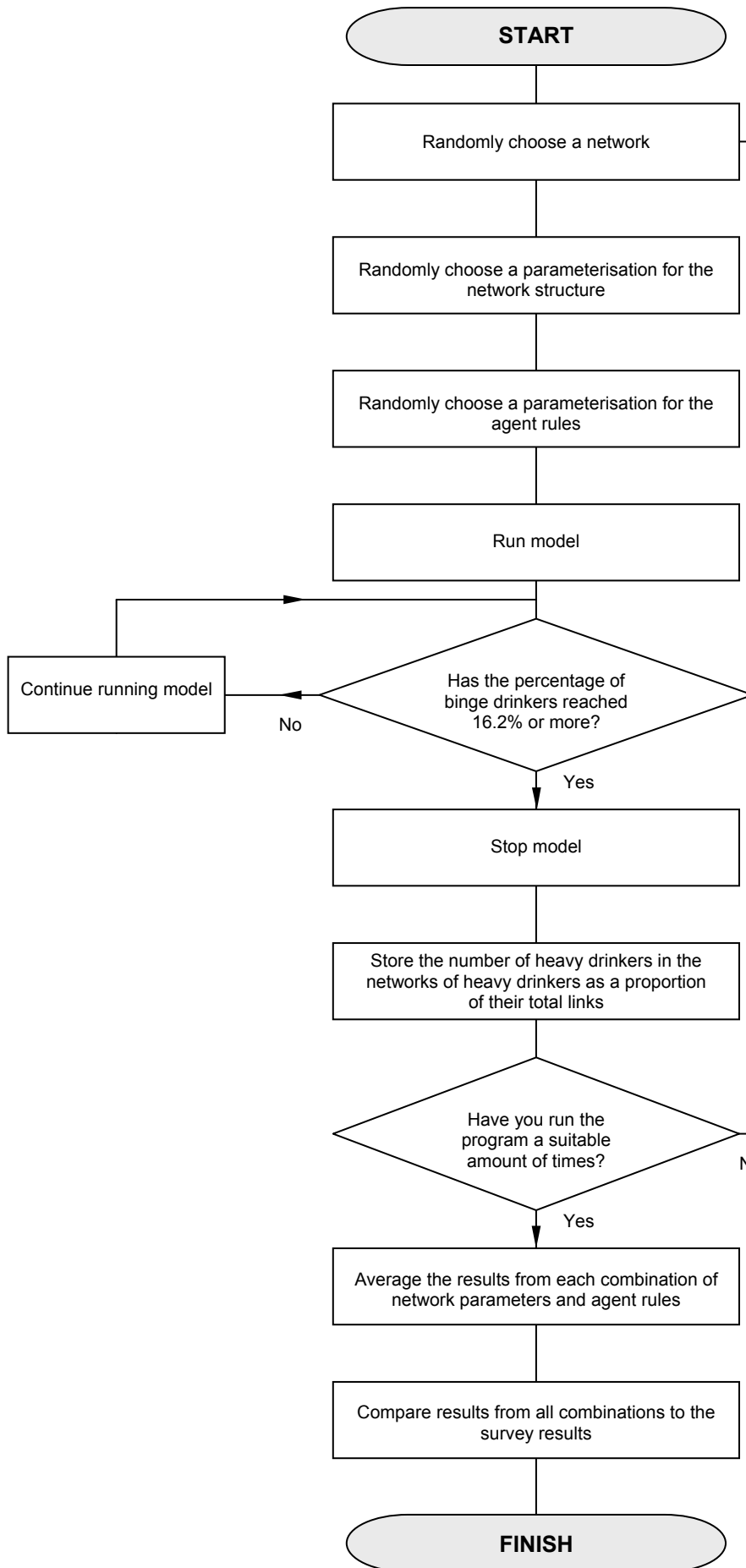


Figure A.3: Flow chart for the methodology for the project

The options are small world (replacement rewiring), small world (additional rewiring), scale free or random

See table A.3

Agents will change from non-binge drinkers to binge drinkers if the proportion of binge drinkers in their network is above their individual threshold.

This threshold is randomly drawn from a uniform threshold between  $L1$  and  $U1$  and is constant throughout the run of a model.

The model is run for up to 20 time steps. If the run fails to reach 16.2% it is discarded.

In each time step each agent is able to assess their network against their threshold and take up binge drinking.

The program must be run a suitably large amount of times so that each possible combination of network parameters and agent rules has been generated and tested. Furthermore each combination must be run a significantly large number of times so that the average behaviour can be determined as not all runs of the same parameterisation will be equivalent.

In the initial sweep the program was run 40,000 times. Candidate final model parameterisations were run 1000 times each.

Table A.3: Parameters used in the generation of the three types of networks

Application	Parameter	Description	Value/Range
General parameters	$n$	Number of agents in network.	1000
	L1	The lower limit to the distribution for the threshold of agents to switch from not binge drinking to binge drinking based on an evaluation of agents connected to them by their social network.	0
	U1	The upper limit to the distribution for the threshold of agents to switch from not binge drinking to binge drinking based on an evaluation of agents connected to them by their social network.	0.4-0.8
	L2	The lower limit to the distribution for the threshold of agents to switch from binge drinking to not binge drinking based on an evaluation of agents connected to them by their social network.	1.2
	U2	The upper limit to the distribution for the threshold of agents to switch from binge drinking to not binge drinking based on an evaluation of agents connected to them by their social network.	1.2
Small world network	$k$	Number of adjacent agents each agent is linked to on either side.	2-10
	$\phi$	Probability of rewiring a link (either additionally or replacement) when generating network.	0-0.1
Scale free network	$q$	Average number of links each agent makes when it is added to network.	0.5-2
	$\alpha$	Number of initially completely connected agents before generating network.	2-8
Random network	$p$	Probability that any two agents are connected.	0.002-0.025

Table A.4 Average approximate number of links in each type of network

Network Type	Average number of links in network (approximate)
Small world (replacement rewiring)	$2kn$
Small world (additional rewiring)	$2kn + 4kn\phi$
Scale free	$2nq + \alpha(\alpha + 1)$
Random	$pn$

## Results

A summary of results of the initial sifting for each type of network can be found in data tables I-IV at the end of this Appendix.

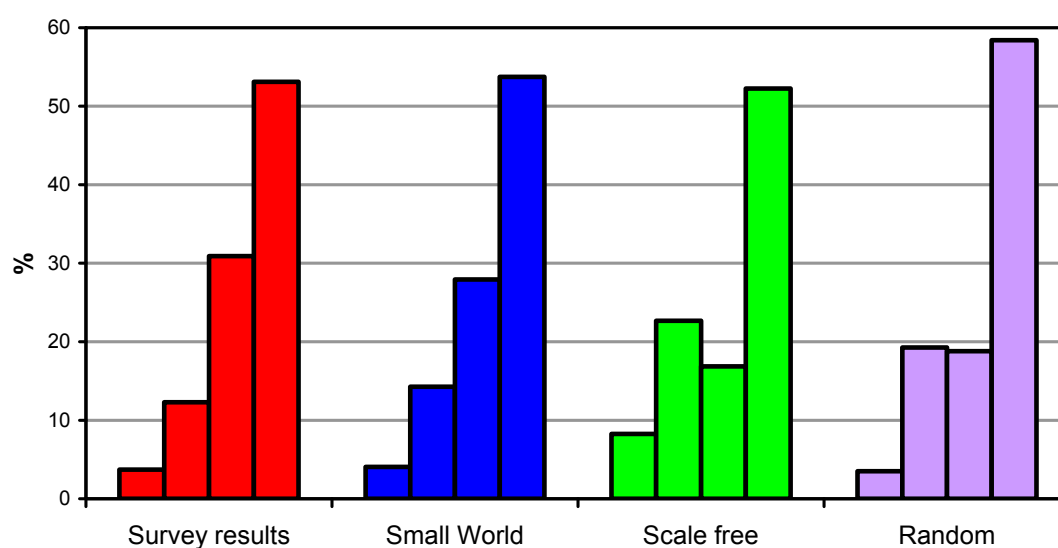
## Evaluating the Results

In order to compare the results for the various models they were scored using the following equation.

$$S = |q_1 - Q_1| + |q_2 - Q_2| + |q_3 - Q_3| + |q_4 - Q_4|$$

Models with a lower  $S$ , or score value, will more closely resemble the survey results. The models from each type of network with the lowest score are shown in Figure A.4<sup>19</sup>. The corresponding parameters are shown in Table A.5.

*Figure A.4: The final candidate models for each type of network with the lowest score value and the questionnaire results for the proportion of the non-binge drinker's friends who are thought to be binge drinkers*



It can be seen that the candidate model for the small world most accurately reproduces the survey results and is therefore the chosen model. It significantly outperforms the other types of networks including the random network which was used as a control. The candidate network models do not reproduce the profile of the quartiles.

<sup>19</sup> Note that only one type of small world network is shown, this is for the version with additional wiring. The level of rewiring is low in the small world ( $\phi \ll 1$ ) so results for both types of small world networks are almost identical.

Table A.5: Parameters for the final candidate models

Network	Parameter	Optimised Value
Small world network	$k$	4
	$\phi$	0.005
	U1	0.5
Scale free network	$q$	1
	$\alpha$	4
	U1	0.8
Random network	$p$	0.002
	U1	0.8

### Robustness Testing & Proof of Optimisation

It is important to test the sensitivity of the results of the chosen model to perturbations in its parameterisation for both network structure and the behavioural rules of the agents. Assessing the robustness of a model is a balancing act, if the results being modelled can be generated either by a too wide a range of models or only one special parameterisation then the degree by which a network can be said to account for the spread of emergent behaviour is diminished.

Figure A.4 shows the effect of keeping all of the model parameters the same except for  $k$ . It shows that  $k=4$  outperforms perturbations values between  $k=2$  and  $k=10$ . The model exhibits the strongest sensitivity to this parameter although increments of two are rather large<sup>20</sup>. The results for  $k=2$  and  $k=6$  fall within the top 37<sup>th</sup> percentile of models with the former exhibiting a different profile shape to the survey results.

The reason for this increased sensitivity is demonstrated in table 6, a change in  $k$  means that the average number of binge drinkers required in the network of a non-binge drinking agent in order for them to switch behaviour varies. When  $k$  is reduced the average number of required binge drinkers falls as well. Similarly when  $k$  increases the average links required increases. In a model where agents make decisions on only integers (i.e. five of seven connections are binge drinkers) and where the increments of  $k$  that can be tested are restricted, changes in  $k$  represent strong transitions in the model which explain the changes in profile observed in Figure A.5.

<sup>20</sup> The increments have to be two so that this generates the four additional links each step, this ensures that there is no biasing of the number of links that are binned into each quartile.

Table A.6: Analysis of the impact of perturbations of  $k$  from the optimised model.

$k$	$\overline{U1}$	Average links to agents who are binge drinkers required to take up binge drinking
2	0.25	0.5
4	0.25	1.0
6	0.25	1.5

Figure A.5: Results for varying  $k$  for the optimised model, shown in red are the questionnaire results and green is the optimised model

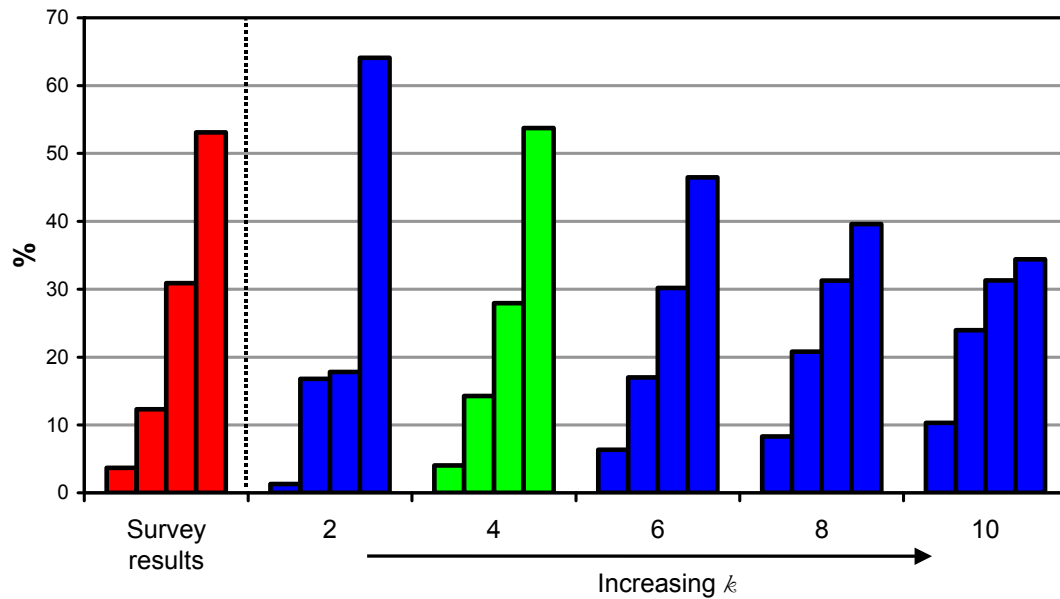


Figure A.6 shows similar results as figure A.5 but  $\phi$  is varied rather than  $k$ . The model still performs well for  $\phi = 0.001$ , five times less than the optimised value, as well as  $\phi = 0.01$ . These models scored within the top 3<sup>rd</sup> percentile of the small world models considered.

Figure A.6: Results for varying  $\phi$  for the optimised model, shown in red are the questionnaire results and green is the optimised model.

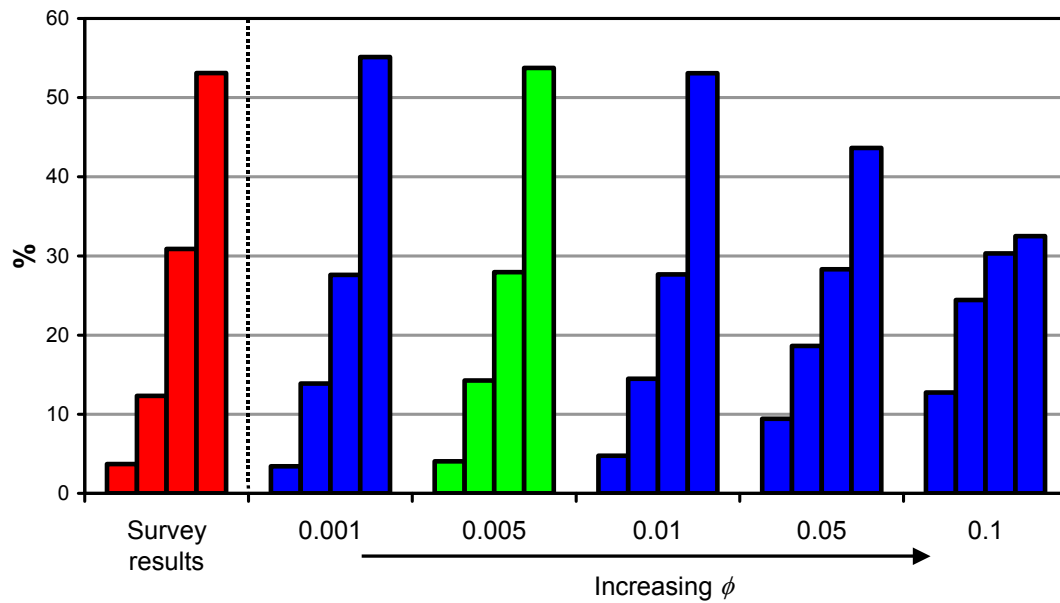
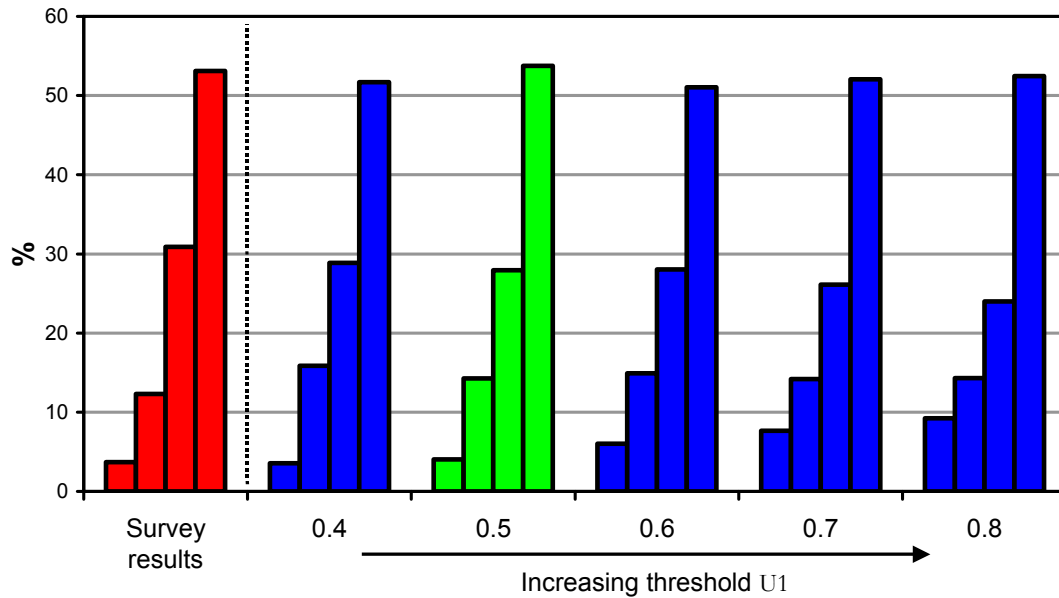


Figure A.7 shows the final test for model robustness where  $U_1$  was varied while  $k$  and  $\phi$  were held constant. It shows that  $U_1=0.5$  out performs perturbations values between  $U_1=0.4$  and  $U_1=0.8$ . Importantly the model still performs well for both  $U_1=0.4$  and  $U_1=0.6$ , the broad shape is similar. These two models were both within the top 5<sup>th</sup> percentile of the small world models considered.

In conclusion the choice of model is robust to both the parameters that define the structure of the network and the choice of rules for the agents to follow. Sensitivity is highest for the parameter  $k$ , this can be explained as an artefact of the restricted choice of  $k$  values available rather than a fundamental inadequacy of the approach.

Figure A.7: Results for varying U1 for the optimised model, shown in red are the questionnaire results and green is the optimised model



## Introducing Social Influences to Stop Binge Drinking

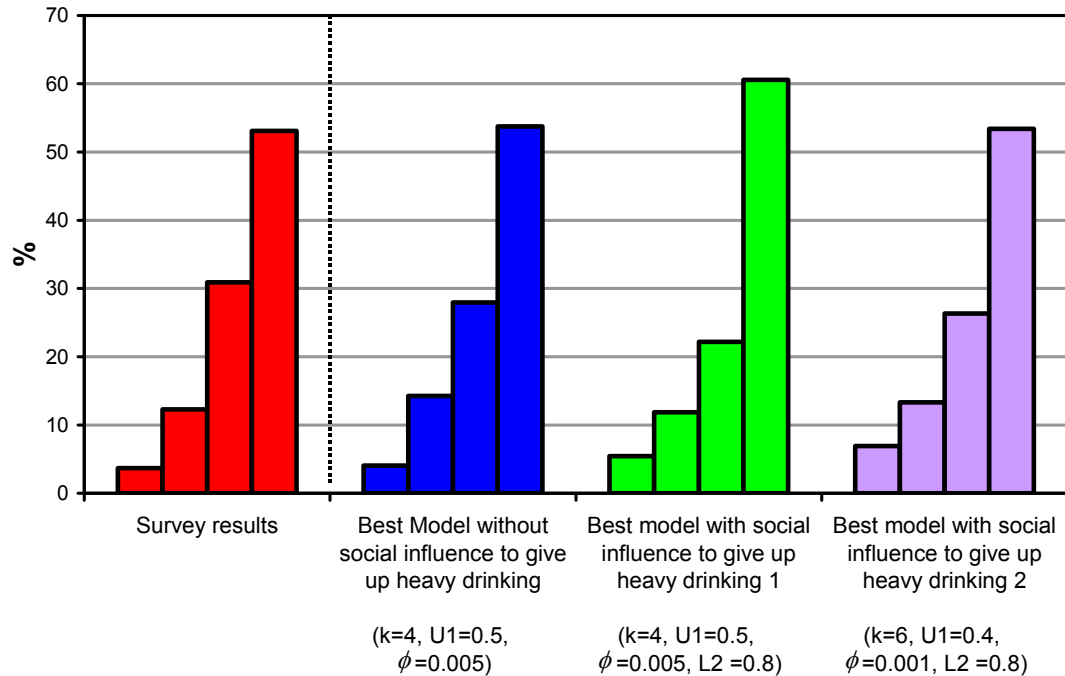
The model rules explored so far have only considered social influence causing agents to take up binge drinking (the so called 0-1 transition), the possibility that social pressure could stimulate people to give up binge drinking (1-0 transitions) has not been explored.

In order to identify candidate models which had similar or better scores to the chosen model and that included 1-0 transitions, the small world model space described in Table A.4 was swept again with L2 values of 0.8, 0.6 and 0.5 and a value of U2 of 1.2 added to the combinations. This means that a proportion of agents will never be able to stop binge drinking if they take it up, irrespective of their network, but that the remaining fraction will give up binge drinking if their network is sufficiently connected to non-binge drinkers.

The candidates for models including 1-0 transitions are shown in Figure A.8 alongside the survey results and the chosen small world model. Two candidate models are shown, firstly a model with the same  $k$ ,  $\phi$  and U1 values as the chosen small world model and secondly the optimum model from the entire parameter space.

Figure A.8 shows that the chosen model, without behavioural rules to give up binge drinking, outperforms the candidates of those that do. The fact that in both of the optimised candidate models the scale of social pressure to give up binge drinking is much lower than that to take it up provides more evidence of the robustness of the chosen model and that social influence to give up binge drinking can be approximated to zero.

Figure A.8: Results from introducing behavioural rules which allow agents to stop binge drinking based on their social network. Shown in red is the questionnaire results and blue is the optimised model. Green shows the model with the best score when U2 was introduced into the optimised model while the purple results show the best model from all available parameterisations.

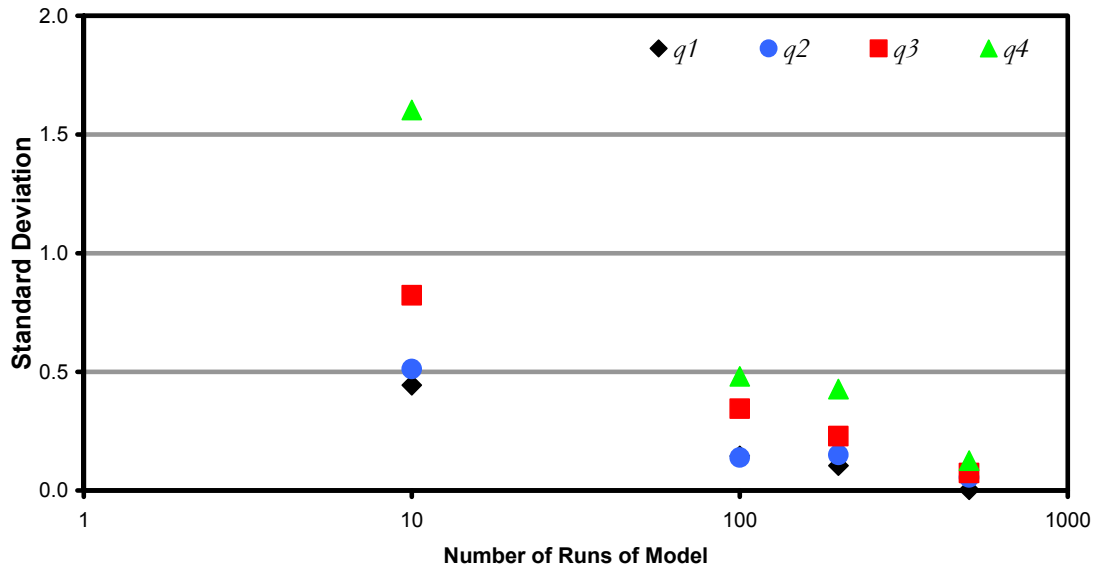


### Analysis of Model Averaging

As shown in Figure A.3 the initial sweeping of the combinations of model parameters was performed 40,000 times which equated to averaging each parameterisation over 300-1000 runs. The candidate models taken forward from this sifting were then run an additional 1000 times. It is important to determine how the results of the models depend on this averaging and how much the results, from any given number of runs, can be expected to vary.

Figure A.9 shows the standard deviations of the averages of set of runs of the model using different numbers of runs. For example the model was run 10 times and the average result calculated, this was repeated 16 times. The standard deviations of these 16 averages are plotted in Figure A.9 for  $q_1$  through to  $q_4$ . It can be seen that the standard deviation drops dramatically as the number of runs in the averaging increases but that it plateaus off for 200 or more runs. Therefore the 1000 runs used in evaluating the candidate models is suitably large that the results can be considered statistically unbiased.

Figure A.9: Standard deviations of each quartile as a function of the number of runs of the model



### Distribution of Quartile Values for the Chosen Model

It is important that the results for  $q_1$  through to  $q_4$  of the chosen model are suitably distributed across the 1000 runs. If they were uniformly distributed then the results would hold little value. It is important that each result is suitably distributed around its mean. Figures A.10-A.13 show histograms of the values of  $q_1$  through to  $q_4$  from 1000 runs respectively. Each result is suitably distributed, however it is noticeable that  $q_4$  has the largest full width half maximum (FWHM) and is therefore the most variable result from the model.

Figure A.10: Histogram of the value of  $q_1$  from 1000 runs of the chosen model

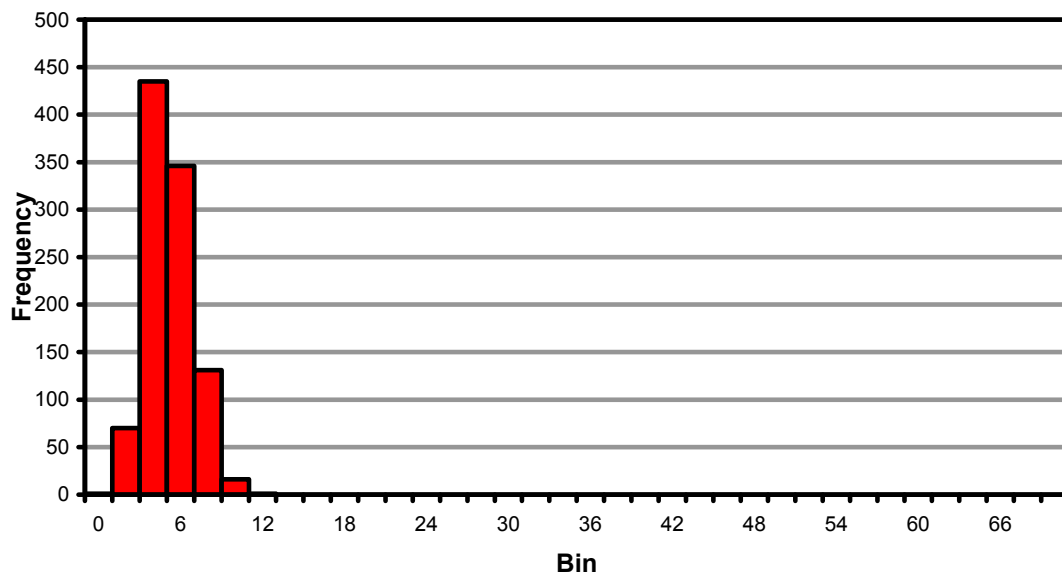


Figure A.11: Histogram of the value of  $q_2$  from 1000 runs of the chosen model

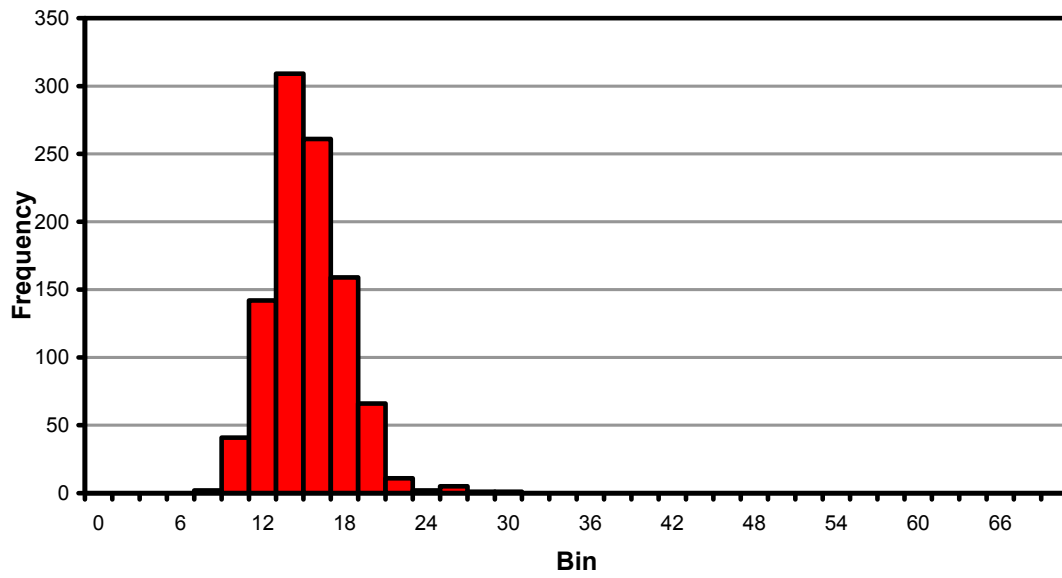


Figure A.12: Histogram of the value of  $q_3$  from 1000 runs of the chosen model

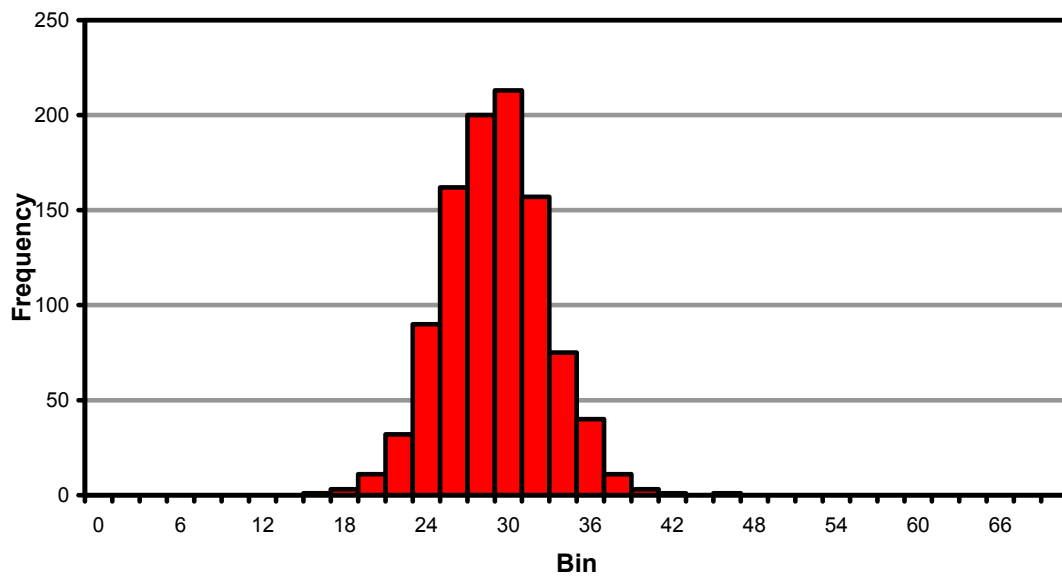
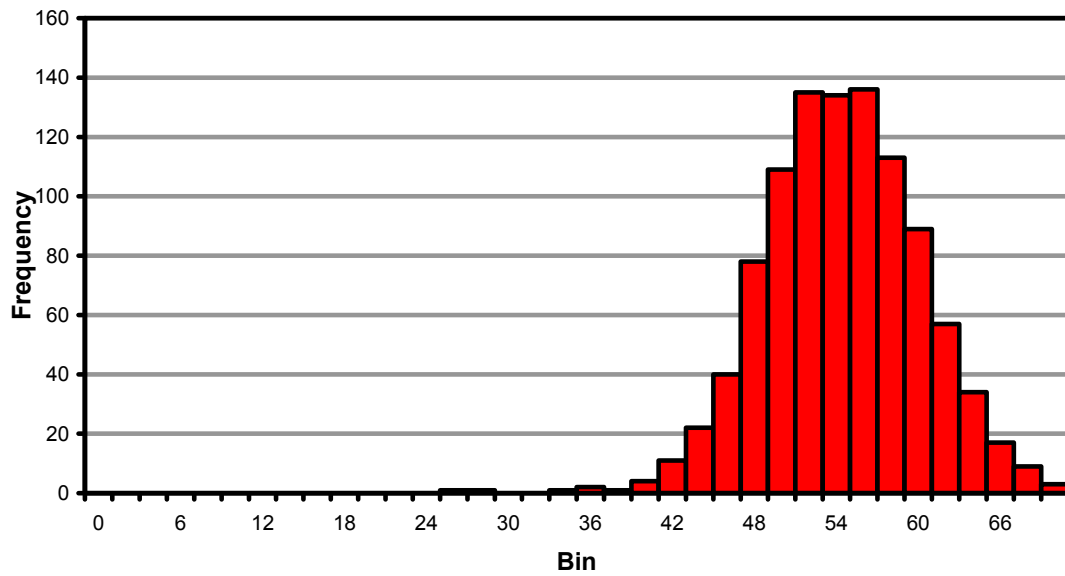


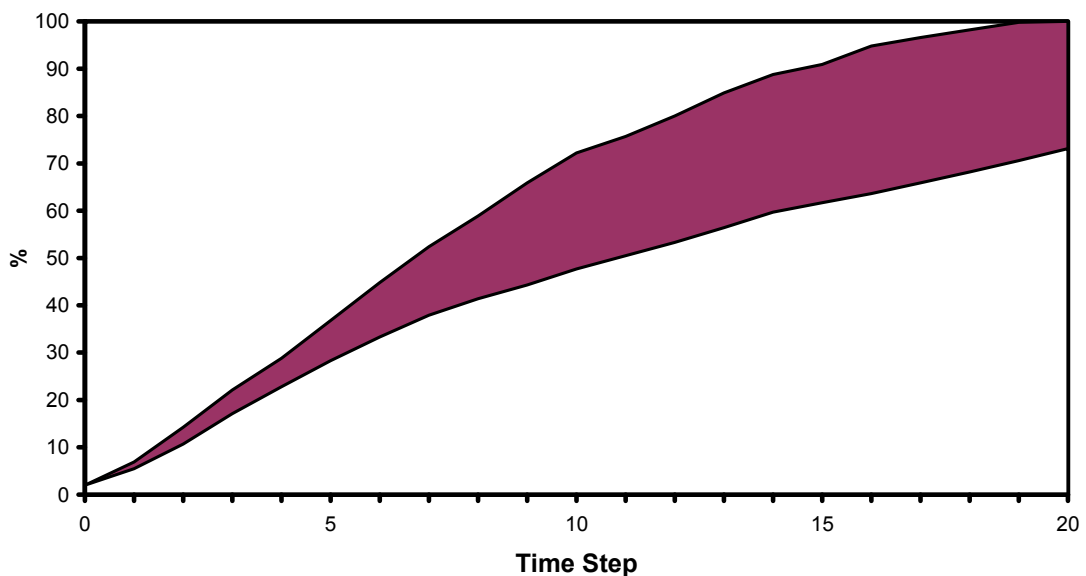
Figure A.13: Histogram of the value of  $q_4$  from 1000 runs of the chosen model



### Long Run Evolution of Chosen Model

The final analysis of the model is its long term evolution past the time step when it reaches greater than or equal to 16.2%. Figure A.14 shows the model evolves to much higher levels of binge drinking than 16.2% but that it does not percolate through the whole of the network all of the time.

Figure A.14: Range of evolution of binge drinking as a proportion of the agents through 20 time steps



**Data Table 1: Results For Small World Networks (Additional Rewiring)**

U1	$\kappa$	$\phi$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score (S)
				$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
				( $q_1$ )	( $q_2$ )	( $q_3$ )	( $q_4$ )	
0.4	2	0.001	490	0.5	17.0	18.1	64.3	<b>31.9</b>
0.4	2	0.005	480	1.1	17.3	18.2	63.4	<b>30.6</b>
0.4	2	0.010	480	1.8	17.3	18.3	62.6	<b>29.1</b>
0.4	2	0.050	480	5.6	19.0	19.1	56.2	<b>23.5</b>
0.4	2	0.100	440	8.4	21.6	21.2	48.8	<b>28.0</b>
0.4	4	0.001	360	2.9	15.3	28.8	53.0	<b>6.0</b>
0.4	4	0.005	480	3.6	15.9	28.9	51.7	<b>7.2</b>
0.4	4	0.010	420	4.4	15.8	28.6	51.1	<b>8.6</b>
0.4	4	0.050	510	9.4	20.3	29.0	41.4	<b>27.3</b>
0.4	4	0.100	580	13.7	26.7	30.4	29.1	<b>48.9</b>
0.4	6	0.000	460	6.7	21.7	32.5	39.0	<b>28.1</b>
0.4	6	0.001	430	7.0	22.2	32.8	38.0	<b>30.3</b>
0.4	6	0.005	610	7.6	22.0	32.9	37.5	<b>31.3</b>
0.4	6	0.010	370	8.6	22.9	32.8	35.7	<b>34.8</b>
0.4	6	0.050	450	13.1	27.5	31.0	28.4	<b>49.3</b>
0.4	6	0.100	410	18.3	34.3	30.5	16.9	<b>73.1</b>
0.4	8	0.000	520	10.9	27.7	32.5	28.8	<b>48.6</b>
0.4	8	0.001	450	10.7	28.0	32.4	28.9	<b>48.4</b>
0.4	8	0.005	1000	11.6	28.7	31.8	27.9	<b>50.4</b>
0.4	8	0.010	1080	12.3	29.1	31.7	26.9	<b>52.4</b>
0.4	8	0.050	560	16.9	34.6	30.0	18.5	<b>71.0</b>
0.4	8	0.100	450	21.9	39.2	27.1	11.8	<b>90.3</b>
0.4	10	0.000	690	14.4	33.1	30.6	21.9	<b>63.1</b>
0.4	10	0.001	440	14.9	33.4	30.3	21.4	<b>64.6</b>
0.4	10	0.005	820	15.1	33.6	30.5	20.8	<b>65.4</b>
0.4	10	0.010	810	16.0	34.1	29.9	20.0	<b>68.2</b>
0.4	10	0.050	530	19.6	37.7	27.7	15.0	<b>82.7</b>
0.4	10	0.100	560	25.3	42.6	23.9	8.2	<b>103.9</b>
0.5	2	0.001	460	0.8	16.4	17.2	65.6	<b>33.2</b>
0.5	2	0.005	510	1.3	16.8	17.8	64.1	<b>31.0</b>
0.5	2	0.010	930	2.0	17.2	18.4	62.4	<b>28.4</b>
0.5	2	0.050	950	5.9	19.9	21.3	52.9	<b>19.7</b>
0.5	2	0.100	1010	9.4	23.2	24.0	43.4	<b>33.1</b>
0.5	2	0.200	530	13.0	29.7	27.2	30.0	<b>53.5</b>
0.5	4	0.001	560	3.4	13.9	27.6	55.1	<b>7.2</b>
0.5	4	0.005	360	4.0	14.3	27.9	53.7	<b>5.9</b>
0.5	4	0.010	960	4.8	14.5	27.7	53.1	<b>6.5</b>
0.5	4	0.050	770	9.4	18.6	28.3	43.6	<b>24.1</b>
0.5	4	0.100	1120	12.8	24.4	30.3	32.5	<b>42.4</b>
0.5	4	0.200	390	17.3	35.4	32.0	15.4	<b>75.4</b>
0.5	6	0.000	380	5.4	16.5	30.3	47.8	<b>11.9</b>
0.5	6	0.001	380	5.5	16.2	30.2	48.1	<b>11.4</b>
0.5	6	0.005	480	6.3	17.0	30.2	46.5	<b>14.7</b>
0.5	6	0.010	960	6.9	17.1	29.6	46.3	<b>16.1</b>

U1	$\kappa$	$\phi$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score (S)
				$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
				( $q_1$ )	( $q_2$ )	( $q_3$ )	( $q_4$ )	
0.5	6	0.050	850	11.5	21.9	30.3	36.3	34.8
0.5	6	0.100	1060	15.3	29.0	32.2	23.5	59.2
0.5	6	0.200	380	20.2	40.7	30.9	8.3	89.7
0.5	8	0.000	660	7.7	20.0	31.0	41.3	23.6
0.5	8	0.001	510	7.7	20.0	30.9	41.5	23.3
0.5	8	0.005	1170	8.3	20.8	31.3	39.6	27.0
0.5	8	0.010	1670	8.8	20.8	30.9	39.5	27.3
0.5	8	0.050	830	13.6	26.7	30.9	28.8	48.6
0.5	8	0.100	890	17.5	33.5	31.9	17.1	72.0
0.5	8	0.200	320	21.8	46.1	27.4	4.7	103.8
0.5	10	0.000	400	9.4	24.0	31.7	34.8	36.6
0.5	10	0.001	550	9.5	23.5	31.6	35.4	35.4
0.5	10	0.005	800	10.3	24.0	31.3	34.4	37.4
0.5	10	0.010	1050	10.8	24.5	31.5	33.2	39.8
0.5	10	0.050	570	15.2	30.6	31.4	22.8	60.6
0.5	10	0.100	300	18.8	37.6	31.3	12.3	81.6
0.6	2	0.001	430	2.7	15.5	17.9	63.9	28.1
0.6	2	0.005	490	3.1	15.8	18.4	62.7	26.2
0.6	2	0.010	1120	3.7	16.3	19.0	61.1	23.8
0.6	2	0.050	1080	6.9	19.4	22.2	51.4	20.7
0.6	2	0.100	980	9.8	23.1	25.0	42.1	33.8
0.6	2	0.200	540	13.9	31.1	28.5	26.6	57.9
0.6	4	0.001	460	5.3	14.4	27.6	52.6	7.4
0.6	4	0.005	540	6.0	14.9	28.0	51.0	9.9
0.6	4	0.010	1120	6.8	15.4	28.0	49.9	12.3
0.6	4	0.050	860	11.4	20.4	28.8	39.4	31.6
0.6	4	0.100	890	15.3	27.9	30.2	26.6	54.4
0.6	4	0.200	450	21.4	39.1	29.1	10.5	89.0
0.6	6	0.000	440	8.4	19.8	30.9	40.9	24.3
0.6	6	0.001	470	8.3	19.9	30.8	40.9	24.5
0.6	6	0.005	490	9.1	19.8	30.7	40.3	25.9
0.6	6	0.010	920	9.7	20.8	30.8	38.7	29.1
0.6	6	0.050	920	15.0	27.0	30.9	27.1	52.0
0.6	6	0.100	940	19.7	34.1	30.4	15.8	75.5
0.6	6	0.200	450	27.3	45.2	23.5	4.0	113.0
0.6	8	0.000	520	11.4	25.3	31.9	31.3	43.5
0.6	8	0.001	630	11.2	24.7	31.7	32.4	41.3
0.6	8	0.005	420	12.2	25.1	31.8	30.9	44.4
0.6	8	0.010	850	12.9	25.9	31.4	29.8	46.6
0.6	8	0.050	970	18.2	32.3	30.5	19.1	68.9
0.6	8	0.100	910	23.5	39.2	27.8	9.5	93.4
0.6	8	0.200	510	32.1	48.7	17.7	1.5	129.6
0.6	10	0.000	430	14.4	30.3	31.5	23.8	58.5
0.6	10	0.001	380	14.1	29.8	31.2	24.9	56.4
0.6	10	0.005	490	15.3	30.9	31.0	22.8	60.6
0.6	10	0.010	430	15.8	31.3	31.5	21.4	63.3
0.6	10	0.050	610	21.1	37.7	28.3	12.9	85.7

U1	$\kappa$	$\phi$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score (S)
				$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
				( $q_1$ )	( $q_2$ )	( $q_3$ )	( $q_4$ )	
0.6	10	0.100	600	27.1	43.3	24.2	5.4	108.8
0.7	2	0.001	390	3.3	15.9	16.4	64.4	29.9
0.7	2	0.005	510	3.5	16.5	17.1	62.9	28.0
0.7	2	0.010	890	4.1	16.6	17.9	61.4	26.0
0.7	2	0.050	830	7.3	19.7	22.3	50.6	22.1
0.7	2	0.100	870	10.1	23.8	25.8	40.2	35.9
0.7	2	0.200	420	14.2	32.7	28.8	24.3	61.8
0.7	4	0.001	480	6.9	13.9	26.3	52.9	9.6
0.7	4	0.005	360	7.7	14.2	26.1	52.0	11.7
0.7	4	0.010	1020	8.4	15.0	26.4	50.3	14.7
0.7	4	0.050	970	12.9	20.8	28.2	38.1	35.4
0.7	4	0.100	980	16.8	28.4	29.8	25.0	58.4
0.7	4	0.200	530	23.3	40.7	27.4	8.6	96.1
0.7	6	0.001	410	9.5	18.5	29.6	42.4	24.0
0.7	6	0.005	390	10.4	18.8	29.9	40.9	26.4
0.7	6	0.010	1040	11.1	19.2	29.5	40.2	28.7
0.7	6	0.050	800	16.4	26.7	30.2	26.7	54.2
0.7	6	0.100	1000	21.6	34.2	29.7	14.5	79.6
0.7	6	0.200	470	30.0	45.0	22.0	3.0	118.1
0.7	8	0.001	400	12.6	23.4	31.2	32.8	40.5
0.7	8	0.005	490	12.9	23.9	30.8	32.4	41.6
0.7	8	0.010	850	13.6	24.8	31.2	30.4	45.3
0.7	8	0.050	1070	19.1	32.2	30.0	18.6	70.7
0.7	8	0.100	1160	25.2	39.5	27.1	8.2	97.5
0.7	8	0.200	460	34.1	49.1	15.7	1.1	134.4
0.7	10	0.001	530	14.9	28.4	31.2	25.5	55.2
0.7	10	0.005	550	15.5	29.0	30.7	24.9	57.0
0.7	10	0.010	550	16.6	29.2	30.5	23.7	59.6
0.7	10	0.050	400	22.2	36.9	28.4	12.5	86.3
0.7	10	0.100	480	28.6	43.0	23.6	4.7	111.3
0.8	2	0.001	430	3.8	17.3	18.0	60.9	25.8
0.8	2	0.005	530	4.2	17.0	18.1	60.7	25.7
0.8	2	0.010	800	4.9	17.6	18.8	58.6	24.2
0.8	2	0.050	1070	8.3	20.7	22.9	48.2	25.9
0.8	2	0.100	820	11.0	24.8	26.2	38.0	39.5
0.8	2	0.200	530	14.8	34.4	28.6	22.1	66.5
0.8	4	0.001	540	8.6	14.0	24.1	53.2	13.51
0.8	4	0.005	570	9.2	14.3	24.0	52.5	15.08
0.8	4	0.010	1110	10.0	15.1	24.6	50.4	18.15
0.8	4	0.050	960	14.5	21.6	27.2	36.7	40.26
0.8	4	0.100	800	18.4	29.9	29.1	22.6	64.66
0.8	4	0.200	430	25.2	42.0	25.7	7.0	102.53
0.8	6	0.001	540	11.8	17.5	27.1	43.6	26.64
0.8	6	0.005	450	12.2	18.6	27.4	41.8	29.60
0.8	6	0.010	920	13.1	18.8	27.7	40.3	31.90
0.8	6	0.050	960	18.5	26.9	29.1	25.5	58.76
0.8	6	0.100	970	23.6	35.9	28.2	12.3	87.00

U1	$\kappa$	$\phi$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score
				$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
				$(q_1)$	$(q_2)$	$(q_3)$	$(q_4)$	$(S)$
0.8	6	0.200	590	32.8	45.9	19.2	2.1	<b>125.37</b>
0.8	8	0.001	440	13.8	22.4	30.0	33.9	<b>40.33</b>
0.8	8	0.005	500	14.7	23.3	30.1	32.0	<b>43.84</b>
0.8	8	0.010	1030	15.7	23.9	29.5	30.9	<b>47.22</b>
0.8	8	0.050	860	21.6	32.5	29.1	16.8	<b>76.15</b>
0.8	8	0.100	890	28.1	40.7	24.9	6.3	<b>105.49</b>
0.8	8	0.200	440	37.7	47.7	13.9	0.7	<b>138.83</b>
0.8	10	0.001	490	16.6	27.1	30.6	25.7	<b>55.31</b>
0.8	10	0.005	560	17.4	27.3	30.1	25.2	<b>57.30</b>
0.8	10	0.010	480	18.3	29.0	30.0	22.6	<b>62.71</b>
0.8	10	0.050	570	24.8	37.0	26.7	11.5	<b>91.57</b>
0.8	10	0.100	460	31.9	43.3	20.9	3.9	<b>118.33</b>

**Data Table II: Results For Small World Networks (Replacement Rewiring)**

U1	$k_c$	$\phi$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score (S)
				$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
				( $q_1$ )	( $q_2$ )	( $q_3$ )	( $q_4$ )	
0.5	2	0.01	480	2.4	17.0	19.2	61.4	<b>26.0</b>
0.5	2	0.05	440	7.3	19.2	24.0	49.5	<b>21.0</b>
0.5	2	0.1	400	11.0	23.1	26.1	39.7	<b>36.3</b>
0.5	2	0.2	430	14.6	30.1	26.9	28.4	<b>57.4</b>
0.5	4	0.01	450	4.9	15.0	28.2	52.0	<b>7.8</b>
0.5	4	0.05	510	10.0	19.6	30.3	40.1	<b>27.2</b>
0.5	4	0.1	410	14.3	27.1	31.7	26.9	<b>52.4</b>
0.5	4	0.2	530	18.8	40.2	29.5	11.5	<b>86.1</b>
0.5	6	0.01	410	7.0	17.4	30.6	44.9	<b>16.9</b>
0.5	6	0.05	510	12.2	23.1	31.6	33.1	<b>40.0</b>
0.5	6	0.1	370	16.8	31.9	32.6	18.6	<b>69.0</b>
0.5	6	0.2	450	22.0	47.7	25.5	4.7	<b>107.5</b>
0.5	8	0.01	410	8.9	20.9	31.7	38.6	<b>29.0</b>
0.5	8	0.05	590	13.9	27.3	32.3	26.5	<b>53.3</b>
0.5	8	0.1	420	18.6	36.5	31.3	13.5	<b>79.1</b>
0.5	8	0.2	380	22.5	53.4	22.0	2.1	<b>119.8</b>
0.6	2	0.01	440	3.8	16.0	19.9	60.3	<b>22.1</b>
0.6	2	0.05	480	7.5	18.7	25.6	48.2	<b>20.4</b>
0.6	2	0.1	480	10.4	22.8	28.7	38.1	<b>34.5</b>
0.6	2	0.2	440	13.7	31.0	29.2	26.1	<b>57.4</b>
0.6	4	0.01	520	6.8	15.4	27.9	49.9	<b>12.4</b>
0.6	4	0.05	390	11.8	21.5	30.8	35.9	<b>34.6</b>
0.6	4	0.1	470	16.5	29.4	31.7	22.4	<b>61.4</b>
0.6	4	0.2	490	22.6	43.1	26.4	7.8	<b>99.5</b>
0.6	6	0.01	390	9.7	20.3	31.4	38.6	<b>28.9</b>
0.6	6	0.05	360	15.6	27.0	31.7	25.7	<b>54.9</b>
0.6	6	0.1	390	21.0	36.1	30.0	12.9	<b>82.2</b>
0.6	6	0.2	440	28.6	50.5	18.7	2.2	<b>126.2</b>
0.6	8	0.01	460	13.2	26.6	32.0	28.3	<b>49.7</b>
0.6	8	0.05	540	18.7	33.6	30.6	17.1	<b>72.6</b>
0.6	8	0.1	550	24.7	41.3	26.4	7.6	<b>99.9</b>
0.6	8	0.2	440	33.3	53.1	12.9	0.7	<b>140.9</b>
0.7	2	0.01	450	4.2	16.4	19.3	60.1	<b>23.3</b>
0.7	2	0.05	540	7.5	19.2	26.9	46.4	<b>21.5</b>
0.7	2	0.1	510	10.1	23.6	30.3	35.9	<b>35.6</b>
0.7	2	0.2	540	13.2	32.0	31.2	23.6	<b>59.1</b>
0.7	4	0.01	430	8.5	15.0	26.9	49.6	<b>15.1</b>
0.7	4	0.05	560	13.1	21.8	30.1	35.1	<b>37.7</b>
0.7	4	0.1	460	17.6	31.2	31.1	20.1	<b>66.0</b>
0.7	4	0.2	580	23.5	45.3	24.9	6.3	<b>105.6</b>
0.7	6	0.01	430	10.8	19.7	30.4	39.1	<b>29.0</b>

U1	$k$	$\phi$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score
				$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
				$(q_1)$	$(q_2)$	$(q_3)$	$(q_4)$	
0.7	6	0.05	440	16.5	27.2	31.2	25.1	<b>56.0</b>
0.7	6	0.1	380	22.2	37.3	28.8	11.7	<b>87.0</b>
0.7	6	0.2	490	30.5	50.8	16.9	1.7	<b>130.7</b>
0.7	8	0.01	570	13.6	25.1	31.2	30.1	<b>46.0</b>
0.7	8	0.05	550	19.9	33.0	30.1	16.9	<b>73.8</b>
0.7	8	0.1	500	26.6	41.8	25.3	6.3	<b>104.9</b>
0.7	8	0.2	550	35.9	52.9	10.7	0.4	<b>145.7</b>
0.8	2	0.01	500	4.8	17.2	20.1	57.8	<b>21.5</b>
0.8	2	0.05	490	8.5	20.4	26.8	44.4	<b>25.7</b>
0.8	2	0.1	460	10.5	24.8	31.1	33.6	<b>38.9</b>
0.8	2	0.2	310	13.4	33.6	31.2	21.8	<b>62.6</b>
0.8	4	0.01	480	9.8	15.8	25.5	49.0	<b>19.1</b>
0.8	4	0.05	470	14.4	23.2	29.0	33.5	<b>43.1</b>
0.8	4	0.1	520	18.7	32.3	30.5	18.5	<b>70.0</b>
0.8	4	0.2	480	25.1	47.4	22.6	4.8	<b>113.1</b>
0.8	6	0.01	450	13.1	18.9	28.0	40.0	<b>32.1</b>
0.8	6	0.05	540	18.6	28.3	30.2	23.0	<b>61.7</b>
0.8	6	0.1	500	24.5	38.1	27.7	9.7	<b>93.2</b>
0.8	6	0.2	480	33.2	51.3	14.4	1.1	<b>136.9</b>
0.8	8	0.01	500	15.8	23.9	29.7	30.7	<b>47.2</b>
0.8	8	0.05	430	22.2	32.8	29.5	15.6	<b>77.9</b>
0.8	8	0.1	520	29.2	43.0	23.0	4.8	<b>112.4</b>
0.8	8	0.2	420	38.5	52.3	9.0	0.3	<b>149.5</b>

**Data Table III: Results For Scale Free Networks**

U1	$\alpha$	$q$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score (S)
				$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
				$(q_1)$	$(q_2)$	$(q_3)$	$(q_4)$	
0.5	2	0.5	460	8.4	12.6	6.7	72.2	<b>48.4</b>
0.5	2	1.0	550	8.4	24.7	14.0	52.8	<b>34.3</b>
0.5	2	1.5	370	10.3	32.4	18.7	38.6	<b>53.4</b>
0.5	2	2.0	340	12.4	38.3	21.1	28.2	<b>69.4</b>
0.5	2	4.0	40	21.8	48.9	20.3	9.0	<b>109.3</b>
0.5	2	6.0	60	25.6	54.9	16.2	3.3	<b>128.8</b>
0.5	2	8.0	60	29.3	57.8	11.7	1.2	<b>142.4</b>
0.5	3	0.5	400	8.5	13.3	6.7	71.5	<b>48.4</b>
0.5	3	1.0	280	8.4	24.9	13.9	52.7	<b>34.7</b>
0.5	3	1.5	560	10.1	32.9	18.5	38.4	<b>54.2</b>
0.5	3	2.0	500	12.2	37.8	21.4	28.6	<b>68.0</b>
0.5	3	4.0	80	21.7	49.7	19.8	8.7	<b>110.8</b>
0.5	3	6.0	70	25.6	55.5	15.9	3.1	<b>130.2</b>
0.5	3	8.0	100	30.8	57.7	10.6	1.0	<b>144.9</b>
0.5	4	0.5	500	8.3	13.0	6.7	72.0	<b>48.5</b>
0.5	4	1.0	490	8.6	24.9	14.2	52.3	<b>35.0</b>
0.5	4	1.5	470	10.0	32.7	18.7	38.6	<b>53.4</b>
0.5	4	2.0	590	12.5	38.1	21.2	28.1	<b>69.4</b>
0.5	4	4.0	140	21.0	49.0	20.7	9.3	<b>108.1</b>
0.5	4	6.0	120	27.4	55.1	14.8	2.7	<b>133.0</b>
0.5	4	8.0	140	30.8	57.8	10.5	1.0	<b>145.1</b>
0.5	5	0.5	510	8.4	13.3	6.5	71.8	<b>48.7</b>
0.5	5	1.0	510	8.6	25.0	14.1	52.3	<b>35.2</b>
0.5	5	1.5	430	10.1	32.9	18.6	38.4	<b>54.0</b>
0.5	5	2.0	470	12.2	38.2	21.1	28.4	<b>68.9</b>
0.5	5	4.0	90	21.3	49.8	19.8	9.1	<b>110.2</b>
0.5	5	6.0	90	25.8	55.0	15.9	3.3	<b>129.6</b>
0.5	5	8.0	120	30.8	57.5	10.6	1.0	<b>144.7</b>
0.6	2	0.5	430	8.5	11.9	8.0	71.7	<b>46.6</b>
0.6	2	1.0	390	8.4	24.0	16.3	51.3	<b>32.7</b>
0.6	2	1.5	410	10.1	32.9	19.7	37.3	<b>54.0</b>
0.6	2	2.0	490	12.3	39.2	21.1	27.4	<b>71.1</b>
0.6	2	4.0	150	22.2	51.7	17.8	8.3	<b>115.7</b>
0.6	2	6.0	140	30.7	54.8	12.1	2.4	<b>139.1</b>
0.6	2	8.0	100	34.7	56.4	8.0	0.8	<b>150.2</b>
0.6	3	0.5	470	8.2	11.8	8.3	71.7	<b>46.2</b>
0.6	3	1.0	410	8.3	23.8	16.2	51.6	<b>32.2</b>
0.6	3	1.5	510	9.9	32.8	20.2	37.1	<b>53.4</b>
0.6	3	2.0	400	12.3	38.9	21.4	27.4	<b>70.4</b>
0.6	3	4.0	150	22.9	50.8	18.0	8.2	<b>115.5</b>
0.6	3	6.0	70	29.9	55.8	12.5	1.9	<b>139.2</b>

U1	$\alpha$	$q$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score (S)
				$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
				$(q_1)$	$(q_2)$	$(q_3)$	$(q_4)$	
0.6	3	8.0	50	34.9	56.7	7.6	0.7	<b>151.3</b>
0.6	4	0.5	430	8.1	11.9	8.2	71.8	<b>46.2</b>
0.6	4	1.0	490	8.5	23.8	16.2	51.4	<b>32.6</b>
0.6	4	1.5	510	9.9	32.8	19.6	37.8	<b>53.3</b>
0.6	4	2.0	540	12.2	39.2	21.3	27.3	<b>70.8</b>
0.6	4	4.0	120	23.2	51.7	17.2	7.9	<b>117.8</b>
0.6	4	6.0	120	30.2	55.1	12.2	2.5	<b>138.7</b>
0.6	4	8.0	100	36.0	55.4	7.9	0.8	<b>150.7</b>
0.6	5	0.5	490	8.4	11.6	8.1	72.0	<b>47.2</b>
0.6	5	1.0	460	8.2	23.8	16.1	51.8	<b>32.1</b>
0.6	5	1.5	550	9.9	33.1	19.7	37.3	<b>53.9</b>
0.6	5	2.0	560	12.3	39.4	21.2	27.1	<b>71.4</b>
0.6	5	4.0	90	24.0	51.2	17.3	7.5	<b>118.5</b>
0.6	5	6.0	100	29.7	55.8	12.0	2.5	<b>139.0</b>
0.6	5	8.0	130	34.8	56.4	8.0	0.8	<b>150.4</b>
0.7	2	0.5	370	8.0	10.0	8.7	73.3	<b>49.1</b>
0.7	2	1.0	480	8.2	22.9	16.9	52.0	<b>30.2</b>
0.7	2	1.5	500	9.8	33.1	19.8	37.3	<b>53.8</b>
0.7	2	2.0	460	12.2	40.3	20.4	27.2	<b>73.0</b>
0.7	2	4.0	90	23.1	52.8	16.2	7.9	<b>119.8</b>
0.7	2	6.0	80	34.2	54.5	9.2	2.0	<b>145.5</b>
0.7	2	8.0	100	40.9	52.7	5.7	0.6	<b>155.3</b>
0.7	3	0.5	550	8.0	11.2	8.8	72.0	<b>46.4</b>
0.7	3	1.0	550	8.1	23.1	17.1	51.7	<b>30.4</b>
0.7	3	1.5	350	9.7	33.0	20.1	37.2	<b>53.3</b>
0.7	3	2.0	480	12.5	40.4	19.9	27.1	<b>73.9</b>
0.7	3	4.0	80	24.7	52.4	15.0	7.9	<b>122.3</b>
0.7	3	6.0	80	32.5	54.9	10.5	2.1	<b>142.8</b>
0.7	3	8.0	190	40.6	52.9	5.8	0.6	<b>155.1</b>
0.7	4	0.5	450	8.4	11.1	9.0	71.5	<b>46.2</b>
0.7	4	1.0	510	8.0	23.7	16.8	51.5	<b>31.5</b>
0.7	4	1.5	450	9.8	32.9	19.6	37.6	<b>53.5</b>
0.7	4	2.0	530	12.2	40.4	20.3	27.2	<b>73.0</b>
0.7	4	4.0	50	24.8	52.0	15.4	7.8	<b>121.6</b>
0.7	4	6.0	120	32.8	54.8	10.1	2.2	<b>143.3</b>
0.7	4	8.0	80	40.9	52.8	5.7	0.6	<b>155.5</b>
0.7	5	0.5	570	8.4	10.6	8.8	72.1	<b>47.5</b>
0.7	5	1.0	350	8.2	23.5	16.4	51.8	<b>31.5</b>
0.7	5	1.5	400	9.7	33.0	19.8	37.5	<b>53.3</b>
0.7	5	2.0	620	12.0	40.5	20.2	27.3	<b>73.1</b>
0.7	5	4.0	100	23.7	53.0	15.3	8.0	<b>121.4</b>
0.7	5	6.0	140	33.7	54.5	9.7	2.2	<b>144.3</b>
0.7	5	8.0	140	40.8	52.6	5.9	0.7	<b>154.9</b>
0.8	2	0.5	480	9.3	11.9	8.1	70.6	<b>46.3</b>

U1	$\alpha$	$q$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score (S)
				$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
				$(q_1)$	$(q_2)$	$(q_3)$	$(q_4)$	
0.8	2	1.0	530	8.2	23.1	16.6	52.1	<b>30.5</b>
0.8	2	1.5	500	9.7	32.9	19.0	38.5	<b>53.1</b>
0.8	2	2.0	490	12.1	40.9	18.9	28.1	<b>74.0</b>
0.8	2	4.0	160	25.5	53.3	13.6	7.6	<b>125.5</b>
0.8	2	6.0	130	36.2	53.5	8.3	2.0	<b>147.5</b>
0.8	2	8.0	120	44.2	50.6	4.7	0.5	<b>157.5</b>
0.8	3	0.5	340	8.1	9.7	10.1	72.2	<b>47.0</b>
0.8	3	1.0	520	8.0	23.9	16.6	51.5	<b>31.7</b>
0.8	3	1.5	300	9.3	33.6	19.2	37.9	<b>53.9</b>
0.8	3	2.0	470	12.1	41.3	19.1	27.5	<b>74.8</b>
0.8	3	4.0	150	24.9	53.8	13.5	7.7	<b>125.5</b>
0.8	3	6.0	40	34.5	54.4	9.0	2.1	<b>145.9</b>
0.8	3	8.0	100	43.4	50.9	5.1	0.6	<b>156.6</b>
0.8	4	0.5	530	7.6	9.2	9.6	73.6	<b>48.8</b>
0.8	4	1.0	400	8.2	22.7	16.9	52.2	<b>29.8</b>
0.8	4	1.5	400	9.6	33.2	19.0	38.3	<b>53.5</b>
0.8	4	2.0	600	12.0	41.2	19.0	27.8	<b>74.4</b>
0.8	4	4.0	50	25.0	53.4	13.9	7.6	<b>124.9</b>
0.8	4	6.0	90	35.2	54.0	8.7	2.2	<b>146.3</b>
0.8	4	8.0	110	43.5	51.1	4.9	0.6	<b>157.1</b>
0.8	5	0.5	480	7.6	10.0	9.4	73.0	<b>47.6</b>
0.8	5	1.0	440	8.2	23.5	15.9	52.5	<b>31.3</b>
0.8	5	1.5	440	9.2	33.4	19.4	38.1	<b>53.1</b>
0.8	5	2.0	490	12.1	41.0	18.8	28.1	<b>74.3</b>
0.8	5	4.0	140	25.2	52.9	14.3	7.6	<b>124.3</b>
0.8	5	6.0	140	36.0	53.6	8.5	1.9	<b>147.3</b>
0.8	5	8.0	90	43.8	51.0	4.6	0.5	<b>157.7</b>

**Data Table IV: Results For Random Networks**

U1	$p$	Iterations	Average percentage of binge drinkers links which are also binge drinkers				Score
			$\geq 0$ $\leq 25\%$	$>25\%$ $\leq 50\%$	$>50\%$ $\leq 75\%$	$>75\%$ $\leq 100\%$	
			$(q_1)$	$(q_2)$	$(q_3)$	$(q_4)$	
0.5	0.002	610	4.8	20.9	11.8	62.5	<b>38.3</b>
0.5	0.004	590	14.6	36.3	23.8	25.2	<b>69.9</b>
0.5	0.005	1510	18.0	40.1	25.3	16.6	<b>84.1</b>
0.5	0.01	1470	24.0	54.2	19.5	2.3	<b>124.4</b>
0.5	0.015	1300	26.2	62.1	11.4	0.3	<b>144.5</b>
0.5	0.02	1660	27.1	66.2	6.7	0.1	<b>154.5</b>
0.5	0.025	1340	28.2	68.0	3.9	0.0	<b>160.3</b>
0.6	0.002	590	4.3	19.3	15.5	60.8	<b>30.9</b>
0.6	0.004	600	13.3	37.7	25.9	23.1	<b>70.0</b>
0.6	0.005	1540	18.0	42.3	25.8	13.9	<b>88.6</b>
0.6	0.01	1390	30.7	54.9	13.2	1.1	<b>139.3</b>
0.6	0.015	1380	38.1	56.6	5.3	0.1	<b>157.2</b>
0.6	0.02	1380	42.9	54.9	2.2	0.0	<b>163.6</b>
0.6	0.025	1750	46.8	52.2	0.9	0.0	<b>166.1</b>
0.7	0.002	730	3.8	19.8	17.5	58.9	<b>26.8</b>
-0.7	0.004	600	13.0	39.4	26.7	20.9	<b>72.8</b>
0.7	0.005	1630	17.6	44.7	25.4	12.3	<b>92.5</b>
0.7	0.01	1570	32.1	55.8	11.1	0.9	<b>143.9</b>
0.7	0.015	1540	40.3	55.6	4.0	0.1	<b>159.8</b>
0.7	0.02	1390	46.3	52.3	1.4	0.0	<b>165.1</b>
0.7	0.025	1360	51.3	48.1	0.5	0.0	<b>167.0</b>
0.8	0.002	620	3.5	19.3	18.8	58.4	<b>24.6</b>
0.8	0.004	660	12.4	41.8	26.1	19.7	<b>76.3</b>
0.8	0.005	1480	17.3	47.0	24.4	11.3	<b>96.6</b>
0.8	0.01	1470	34.2	55.9	9.2	0.7	<b>148.1</b>
0.8	0.015	1790	44.5	52.6	2.9	0.0	<b>162.1</b>
0.8	0.02	1510	52.1	47.0	0.9	0.0	<b>166.2</b>
0.8	0.025	1540	57.7	42.0	0.3	0.0	<b>167.5</b>

## Appendix B: ONS Definitions and Alcohol Unit Conversion

It is useful to compare the definition of binge drinking used for the pilot study with the current ONS definition of 'heavy' or 'binge' drinking. In the UK it appears that 'binge' and 'heavy' drinking are used synonymously. For example the British Medical Association refers to binge drinking behaviours that are based on the ONS definition of heavy drinking (men drinking more than 8 units on at least one day in the last week, and women drinking at least 6 units on at least one day in the last week)<sup>21</sup>.

The latest ONS report on drinking behaviours in the UK distinguishes between recommended daily benchmarks and heavy drinking, where recommended daily benchmarks are more than four units a day for men and three for women; and drinking heavily is defined as more than eight units for men and six for women in a single sitting.

The BMA reports that General Household Survey 2003 data showed that 23 per cent of men and 9 per cent of women had engaged in 'binge drinking' at least once in the last week<sup>22</sup>. This was based on the ONS definition of 'heavy drinking' (men drinking more than 8 units on at least one day in the last week, and women drinking at least 6 units on at least one day in the last week).

The ONA Drinking 2007 report states that: *Overall, 37 per cent of men and 34 per cent of women had exceeded the recommended daily benchmarks of four units for men and three for women on at least one day in the last week. About one half of these drinkers had drunk more than eight units (men) and six units (women).*

The breakdown of these percentages by age group and gender are shown below<sup>23</sup>.

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<sup>21</sup> *Binge drinking*, British Medical Associate, March 2005

<http://www.bma.org.uk/ap.nsf/Content/bindrinkuk?OpenDocument&Highlight=2,binge,drinking>

<sup>22</sup> Office for National Statistics (2004) General Household Survey 2003 cited by BMA at <http://www.bma.org.uk/ap.nsf/Content/bingdrifrefs>

<sup>23</sup> Source: *Drinking: adults' behaviour and knowledge in 2007*, Office of National Statistics, 2008 (p26)

**Table 3.7 Maximum daily amount last week (original and updated methods), by sex and age: 2007**

*All persons*

Maximum daily amount	Men					Women				
	16-24	25-44	45-64	65 and over	Total	16-24	25-44	45-64	65 and over	Total
	%	%	%	%	%	%	%	%	%	%
<b>Original method</b>										
Drank nothing last week	38	32	28	36	32	38	41	39	58	43
Up to 4/3 units	13	26	43	54	36	18	33	44	37	35
More than 4/3, up to 8/6 units	18 <sub>31</sub> <sup>49</sup>	19 <sub>23</sub> <sup>43</sup>	14 <sub>14</sub> <sup>29</sup>	8 <sub>1</sub> <sup>10</sup>	15 <sub>17</sub> <sup>32</sup>	15 <sub>29</sub> <sup>44</sup>	17 <sub>9</sub> <sup>26</sup>	12 <sub>5</sub> <sup>17</sup>	4 <sub>1</sub> <sup>5</sup>	12 <sub>9</sub> <sup>21</sup>
More than 8/6 units										
Base (=100%)	128	341	326	224	1019	164	410	381	239	1194
	%	%	%	%	%	%	%	%	%	%
<b>Updated method</b>										
Drank nothing last week	39	32	28	36	33	38	41	38	59	43
Up to 4/3 units	13	23	34	49	31	13	19	26	30	23
More than 4/3, up to 8/6 units	17 <sub>32</sub> <sup>49</sup>	17 <sub>28</sub> <sup>45</sup>	20 <sub>18</sub> <sup>38</sup>	13 <sub>2</sub> <sup>15</sup>	17 <sub>20</sub> <sup>37</sup>	9 <sub>40</sub> <sup>49</sup>	20 <sub>20</sub> <sup>40</sup>	24 <sub>12</sub> <sup>35</sup>	9 <sub>3</sub> <sup>12</sup>	17 <sub>17</sub> <sup>34</sup>
More than 8/6 units										
Base (=100%)	127	341	326	224	1018	162	411	382	237	1192

As shown above, ONS statistics are reported in terms of units of alcohol. The market research undertaken for the pilot study questioned respondents in terms of numbers of drinks. We have therefore converted the survey responses into an average number of standard alcohol units using the average of the conversion rates shown below.

**Table A1: Conversion of volumes of different types of drink into alcohol units**

Type of drink		Volume (ml)	Estimate of average ABV	Actual units	Units using original method	Units using updated method*
<b>Normal strength beer, lager, cider</b>	half pint	284	4.0%	1.1	1.0	1.0
<b>Strong beer, lager, cider (ABV &gt; 6%)</b>	half pint	284	6.5%	1.8	1.5	2.0
<b>Table wine</b>	glass	125	12.5%	1.6	1.0	1.5
	glass	175	12.5%	2.2	1.0	2.0
	glass	250	12.5%	3.1	1.0	3.0
<b>Fortified wine</b>	glass	50	17.0%	0.9	1.0	1.0
<b>Spirits</b>	single	25	37.5%	0.9	1.0	1.0
<b>Alcopops/coolers</b>	bottle	275	5.0%	1.4	1.5	1.5

\* Note that the actual units have been rounded to the nearest half-unit

Source: *Drinking: adults' behaviour and knowledge in 2007*, Office of National Statistics, 2008 (p77)