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Model-based appraisal of minimum unit pricing for alcohol in Wales

An adaptation of the Sheffield Alcohol Policy Model version 3

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September 2014

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(Views expressed in this report are those of the researcher and not necessarily those of the Welsh Government)

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2 EXECUTIVE SUMMARY

2.1 MAIN CONCLUSIONS

Estimates from the Welsh adaptation of the Sheffield Alcohol Policy Model (version 3) (SAPM3) suggest:

1. Minimum Unit Pricing (MUP) policies would be effective in reducing alcohol consumption, alcohol related harms (including alcohol-related deaths, hospitalisations, crimes and workplace absences) and the costs associated with those harms.
2. A ban on below-cost selling (implemented as a ban on selling alcohol for below the cost of duty plus the VAT payable on that duty) would have a negligible impact on alcohol consumption or related harms.
3. MUP policies would only have a small impact on moderate drinkers. Somewhat larger impacts would be experienced by increasing risk drinkers, with the most substantial effects being experienced by high risk drinkers.
4. MUP policies would have a larger impact on those in poverty, particularly high risk drinkers, than those not in poverty. However; those in poverty also experience larger relative gains in health and the high risk drinkers are estimated to marginally reduce their spending due to their reduced drinking under many policies.

2.2 RESEARCH QUESTIONS

1. What is the estimated impact of MUP policies ranging from 35p-70p per unit if the policies were to be introduced in 2014?
2. What is the estimated impact of a ban on below-cost selling?
3. How do these impacts vary by drinker group (moderate, increasing risk, high risk) and by income group (in poverty, not in poverty)?

2.3 METHODS USED

The Sheffield Alcohol Policy Model (SAPM) has been used previously in England and in Scotland to analyse the potential effects of pricing policies. We have developed a new version of the model to incorporate data and evidence relating to the Welsh population.

This research has obtained data and evidence from available sources as follows:

- Alcohol consumption and demographic information – General Lifestyles Survey (GLF)
- Alcohol purchase transactions and prices paid in off-trade outlets (e.g. supermarkets) and on-trade outlets (e.g. pubs, bars) by different population subgroups – Living Costs and Food Survey (LCF)
- Alcohol price distributions in supermarkets and other off-trade outlets – Nielsen
- Alcohol preferences for different types of beverage by different population subgroups – GLF combined with LCF
- Price elasticities – previously published research
- Hospital admission rates for alcohol-related diseases – NHS Wales hospital admissions data
- Mortality rates for alcohol-related diseases – Office for National Statistics (ONS) mortality data
- Costs of healthcare for alcohol-related diseases – previously published research

- Crime rates – Home Office figures on recorded crime and Ministry of Justice data on conviction rates by population subgroup
- Costs of policing and justice – Home Office estimates of unit costs of crime
- Work absence rates, work participation rates and average salary rates by population subgroups – Quarterly Labour Force Survey (LFS)

The model synthesises all of this data and evidence and models the estimated impact of possible future pricing policies on alcohol consumption, spending, Exchequer and retailer receipts and health, crime and workplace harms.

2.4 SUMMARY OF MODEL FINDINGS

2.4.1 Patterns of drinking and expenditure

F1. The evidence estimates that within the overall Welsh population aged 16+, the proportion of abstainers and people who drink at moderate (less than 21 units per week for men and 14 for women), increasing risk (21-50 units per week for men and 14-35 for women) and high risk (more than 50 units per week for men and 35 for women) levels are 16.0%, 62.5%, 15.8% and 5.7% respectively.

F2. Moderate drinkers consume on average 5.5 units per week, spending £310 per year on alcohol. Increasing risk drinkers consume 27.8 units per week, spending £1,190 per annum, and high risk drinkers consume on average 78.1 units per week, spending £2,960 per annum. These patterns differ somewhat when examined by income group, with moderate drinkers in poverty estimated to drink 4.9 units per week, spending £200 per annum, whilst moderate drinkers above the defined poverty line consume 5.6 units per week and spend £340 per annum.

F3. Overall, increasing and high risk drinkers combined (26% of the population) account for 72% of all alcohol consumption and 65% of all spending on alcohol. High risk drinkers alone (7% of the population) are responsible for 37% of consumption and 31% of all spending.

F4. Prices vary by type of beverage. When examining a potential minimum price for a standard drink (a floor price below which no alcohol may legally be sold) of 50p, the evidence suggests that 72.1% of all off-trade beer, 78.2% of off-trade cider, 41.5% of off-trade wine and 65.5% of off-trade spirits would be affected and incur a price rise.

2.4.2 Effect of modelled policies on consumption and expenditure

F5. For a 50p MUP, the estimated per person reduction in alcohol consumption for the overall population is 4.0%. In absolute terms this equates to an annual reduction of 30.2 units per drinker per year. The lower modelled MUP policies are estimated to have relatively small impacts, with effectiveness increasing sharply above 45p per unit (45p = -2.6%, 50p = -4.0%, 55p = -5.6%).

F6. High risk drinkers have much larger estimated consumption reductions for MUP policies than increasing risk or moderate drinkers. For a 50p MUP the estimated reductions are 7.2% for high risk drinkers, 2.0% for increasing risk drinkers and 2.2% for moderate drinkers. Differences in absolute consumption reductions are considerably larger again, with high risk drinkers reducing their consumption by 293.2 units per year (5.6 per week) for a 50p MUP, compared to a reduction of 28.8 units for increasing risk drinkers and 6.4 units per year for moderate drinkers. Absolute reductions

are also substantially larger for high risk drinkers in poverty (e.g. a reduction of 487.3 units per year vs. 243.0 units per year for high risk drinkers not in poverty).

F7. A ban on below-cost selling is estimated to have almost no impact on population consumption, spending and alcohol-related harms.

F8. Under these policies, drinkers are estimated to reduce consumption but pay slightly more on average per unit consumed, and so estimated percentage changes in spending are smaller than estimated changes in consumption. For all modelled policies, spending across the whole population is estimated to increase, for example by £10 (1.6%) per drinker per year for a 50p MUP alongside a consumption change of -4.0%. Spending changes also differ across the population, with high risk drinkers estimated to spend an extra £32 (1.1%) per year whilst moderate drinkers' spending increases by £2 (0.8%) at 50p MUP. Most of those in poverty are estimated to increase their spending under the majority of policies, with the exception of high risk drinkers in poverty who decrease spending when MUP is 55p or more.

F9. The impact of the policies examined on income subgroups differs hugely. For moderate drinkers, whether those above or below the defined poverty level, the impact is very small. For a 50p MUP, for example, moderate drinkers are estimated to reduce consumption by 6.4 units per year (e.g. around three pints of beer in the year), with a change in spending of on average £2.37 per year (around 5p per week). The effects on moderate drinkers in poverty are even smaller in spending terms, e.g. £2.15 estimated additional spending per annum for a 50p MUP, compared with £2.44 for moderate drinkers not in poverty, though they are higher in consumption terms (a reduction of 10.1 units per year for moderate drinkers in poverty versus 5.3 units per year for moderate drinkers not in poverty). The contrast with high risk drinkers is stark. High risk drinkers in poverty consume over 3,700 units per year, and the modelling estimates that a 50p MUP would reduce consumption in this group by 490 units per annum (-13.0%).

F10. Under all modelled policies (except a ban on below-cost selling), the estimated revenue to the Exchequer (from duty and VAT receipts on alcohol) is estimated to decrease slightly, with a 1.0% reduction (equivalent to £5.8 million) for a 50p MUP. Revenue to retailers is estimated to increase across all policies, with an increase of £27.0 million (3.3%) for a 50p MUP. The vast majority of this is accrued in the off-trade, although on-trade retailers are estimated to gain slightly under most policies (e.g. £2.0 million or 0.3% under a 50p MUP).

2.4.3 Effects of modelled policies on alcohol-related harms

F11. There are substantial estimated reductions in alcohol-related harms from all modelled policies, with an estimated reduction of 53 deaths and 1,400 fewer hospital admissions per year for a 50p MUP. As there is evidence of a time lag between changes in consumption and changes of rates of harm for some alcohol-related health conditions (e.g. various cancer rates increase 10 to 20 years after consumption increases), annual changes in health outcomes are reported at the full effect of the policy (using the 20th year following implementation of the policy as a proxy for this).

F12. All modelled policies are estimated to have greater reductions in deaths and hospital admissions per 100,000 drinkers for those in poverty than those not in poverty (e.g. 5 fewer deaths

and 120 fewer hospital admissions per 100,000 drinkers for those in poverty under a 50p MUP vs. 2 fewer deaths and 50 fewer hospital admissions per 100,000 drinkers for those not in poverty).

F13. Direct costs to healthcare services are estimated to reduce under all modelled policies, with savings of £131 million over 20 years for an MUP threshold of 50p.

F14. Crime is expected to fall, with an estimated 3,684 fewer offences per year under a 50p MUP policy. High risk drinkers, who comprise 5.7% of the population, account for 49% of this reduction. Costs of crime are estimated to reduce by £248 million over 20 years under this policy, with higher MUP thresholds providing even greater savings.

F15. Workplace absence is estimated to fall under all modelled policies, with a reduction of 10,000 days absent per year for a 50p MUP.

F16. For a 50p MUP policy, the total societal value of the harm reductions for health, crime and workplace absence is estimated at £882 million over the 20 year period modelled. This figure includes reduced direct healthcare costs, savings from reduced crime and policing, savings from reduced workplace absence and a financial valuation of the health benefits measured in terms of Quality-Adjusted Life Years (QALYs – valued at £60,000 in line with Home Office guidelines).

3 INTRODUCTION

3.1 BACKGROUND

In 2009, the Sheffield Alcohol Research Group (SARG) at Sheffield University developed the Sheffield Alcohol Policy Model version 2.0 (SAPM) to appraise the potential impact of alcohol policies, including different levels of MUP, for the population of England (1). This model has subsequently been adapted to a range of international settings, including Scotland, Canada and Italy (2–4).

Since 2009, the methodology that underpins SAPM has been further developed and refined. Some of these methodological advances have previously been described elsewhere (5,6); however the present report incorporates a number of additional improvements which are described here. In order to avoid confusion with previous versions of the model, the current version is referred to as SAPM3 throughout this report.

In 2014 SARG were commissioned by the Welsh Government to adapt the Sheffield Model to Wales in order to appraise the potential impact of a range of alcohol pricing policies. The present report represents the results of this work.

3.2 RESEARCH QUESTIONS ADDRESSED

The primary set of policies analysed in this report are Minimum Unit Price (MUP) policies with thresholds of 35p, 40p, …, 70p per unit of alcohol. This analysis uses 2014 as the baseline year for policy implementation and we assume that these price thresholds are held constant in real terms over the length of the 20 year modelling period. The main research questions are concerned with the likely effects of introducing an MUP on alcohol consumption, spending, Exchequer and retailer receipts, health, crime and workplace absenteeism in Wales.

For comparative purposes this report also provides analysis of the impact of the following additional policy options:

1. A 10% general price rise on all alcohol products
2. A ban on 'below-cost selling' – i.e. selling below the cost of duty plus the VAT payable on the duty.

4 METHODS

4.1 OVERVIEW OF SAPM3

The aim of SAPM3 is to appraise pricing policy options via cost-benefit analyses. We have broken down the aims into a linked series of policy impacts to be modelled:

- The effect of the policy on the distribution of prices for different types of alcohol;
- The effect of changes in price distributions on patterns of both on-trade and off-trade alcohol consumption;
- The effect of changes in alcohol consumption patterns on revenue for retailers and the exchequer;
- The effect of changes in alcohol consumption patterns on consumer spending on alcohol;
- The effect of changes in alcohol consumption patterns on levels of alcohol-related health harms;
- The effect of changes in alcohol consumption patterns on levels of crime;
- The effect of changes in alcohol consumption patterns on levels of workplace absenteeism;

To estimate these effects, two connected models have been built:

1. A model of the relationship between alcohol prices and alcohol consumption which accounts for the relationship between average weekly alcohol consumption, the patterns in which that alcohol is drunk and how these are distributed within the population, considering gender, age, income and consumption level.
2. A model of the relationship between i) both average level and patterns of alcohol consumption and ii) harms related to health, crime and workplace absenteeism and the costs associated with these harms.

Figure 4.1 illustrates this conceptual framework.

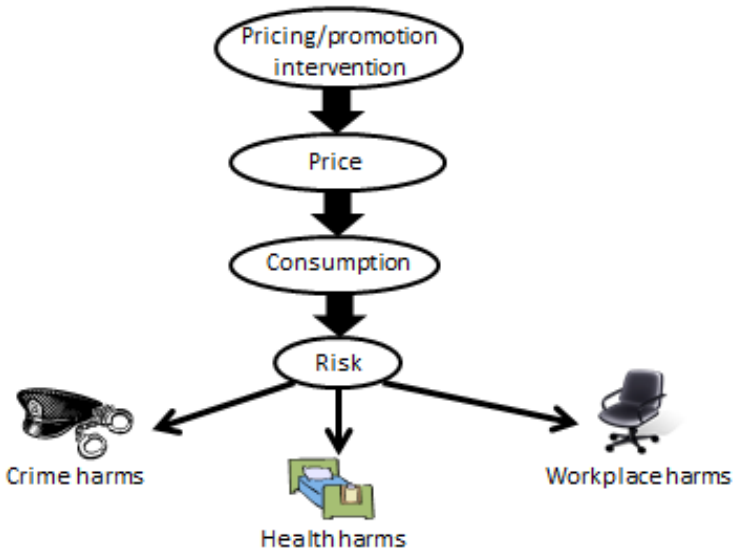


Figure 4.1: High-level conceptual framework of SAPM3

4.2 MODELLING THE LINK BETWEEN INTERVENTION AND CONSUMPTION

4.2.1 Overview

The pricing model uses a simulation framework based on classical econometrics. The fundamental concept is that (i) a current consumption dataset is held for the population; (ii) a policy gives rise to a change in price; (iii) a change in consumption is estimated from the price change using the price elasticity of demand; (iv) the consumption change is used to update the current consumption dataset. Due to data limitations the change in pattern of drinking is estimated indirectly via a change in mean consumption.

As is the case in England, no single dataset exists which contains the necessary data on both prices paid and consumption of alcohol. The link between price and consumption was thus modelled using different datasets. This section provides an overview of the data sources on alcohol consumption and pricing which were used, before detailing the procedures for modelling the effect that price-based policy interventions have on consumption.

4.2.2 Consumption data

The General Lifestyle Survey (GLF) is an annual survey of around 15,000 individuals living in Great Britain. The survey is carried out by the Office for National Statistics (ONS). It records a range of demographic data on respondents, including age, gender, income and mean weekly consumption of alcohol. Data from Welsh respondents within the survey was extracted and pooled to accumulate the required sample size for the baseline population for the model (N=2,123) which included the three most recent years' data (October 2008 to September 2011[1]). Figure 4.2 and Figure 4.3 present the distribution of mean weekly consumption by age and gender respectively.

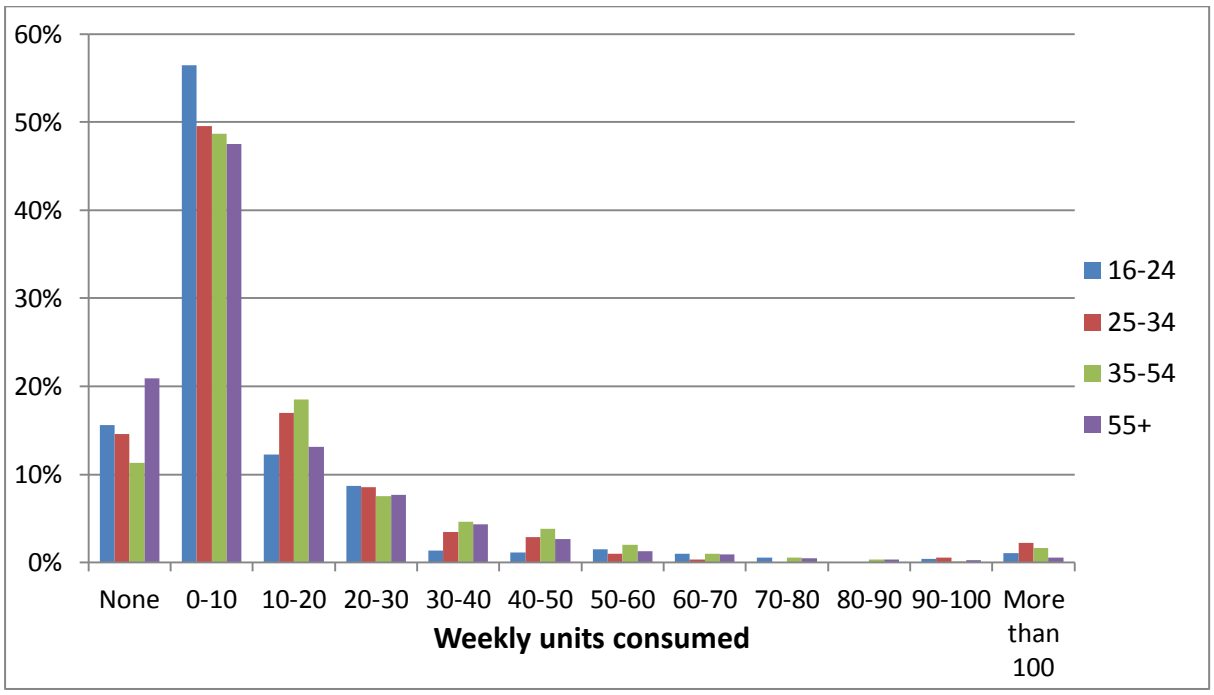


Figure 4.2: Distribution of mean weekly consumption by age group (GLF 2008-2011)

[1] The alcohol consumption element of the GLF was dropped in October 2011.

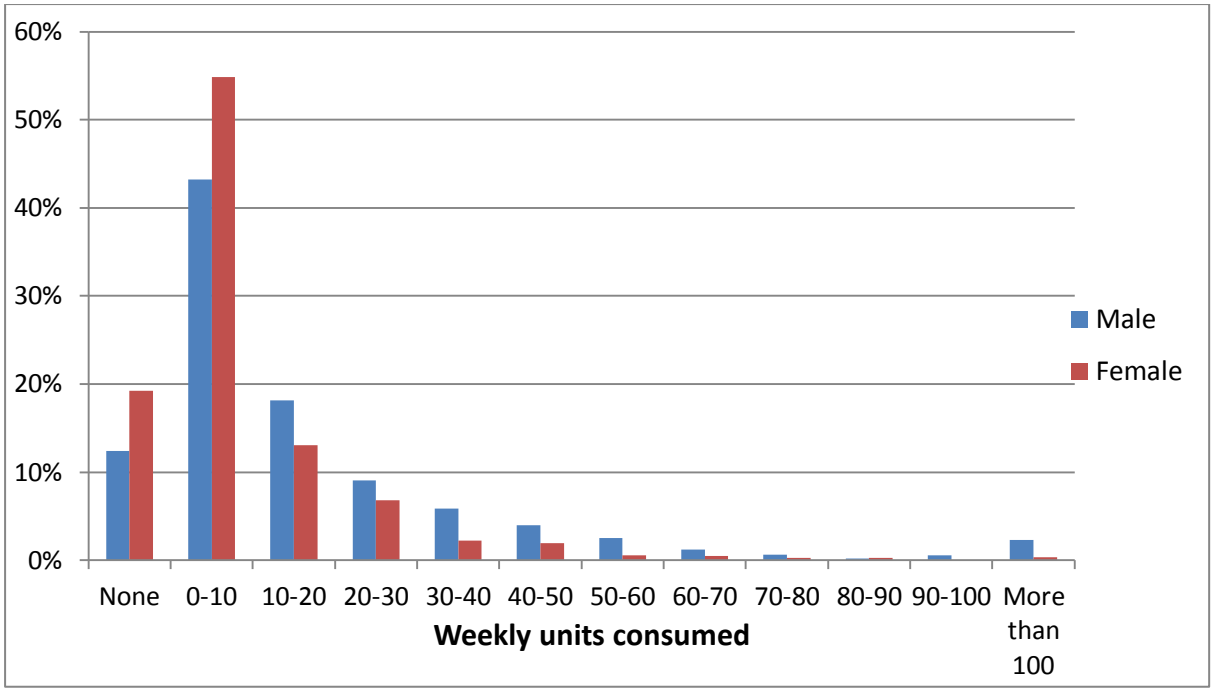


Figure 4.3: Distribution of mean weekly consumption by gender (GLF 2008-2011)

This population is divided into three drinker groups:

- Moderate drinkers – those whose usual alcohol intake is no more than 21/14 units per week for men/women (1 unit = 8g of ethanol)
- Increasing risk drinkers – those drinkers consuming 21-50 units per week for men or 14-35 units per week for women
- High risk drinkers – drinkers whose usual alcohol intake exceeds 50/35 units per week for men/women.

Overall, from the pooled GLF data, 16.0% of the adult population (16+) in Wales are abstainers, 62.5% are moderate drinkers, 15.8% are increasing risk drinkers and 5.7% are high risk drinkers. On average moderate drinkers consume 5.5 units per week, increasing risk drinkers consume 27.8 units and high risk drinkers consume 78.1 units. Figure 4.4 illustrates how consumption patterns differ for the population between those in poverty and those not in poverty[2]. Individuals below the poverty line are more likely to be abstainers (26% vs. 13%) but are almost as likely to drink at high risk levels (5.0% vs. 6.0%). Drinkers below the poverty line drink less on average than those above the poverty line (4.9, 25.9 and 71.7 units per week for moderate, increasing risk and high risk drinkers respectively, compared with 5.6, 28.2 and 79.8 units).

[2] Poverty is defined as an individual having an equivalised household income below 60% of the population median equivalised household income.

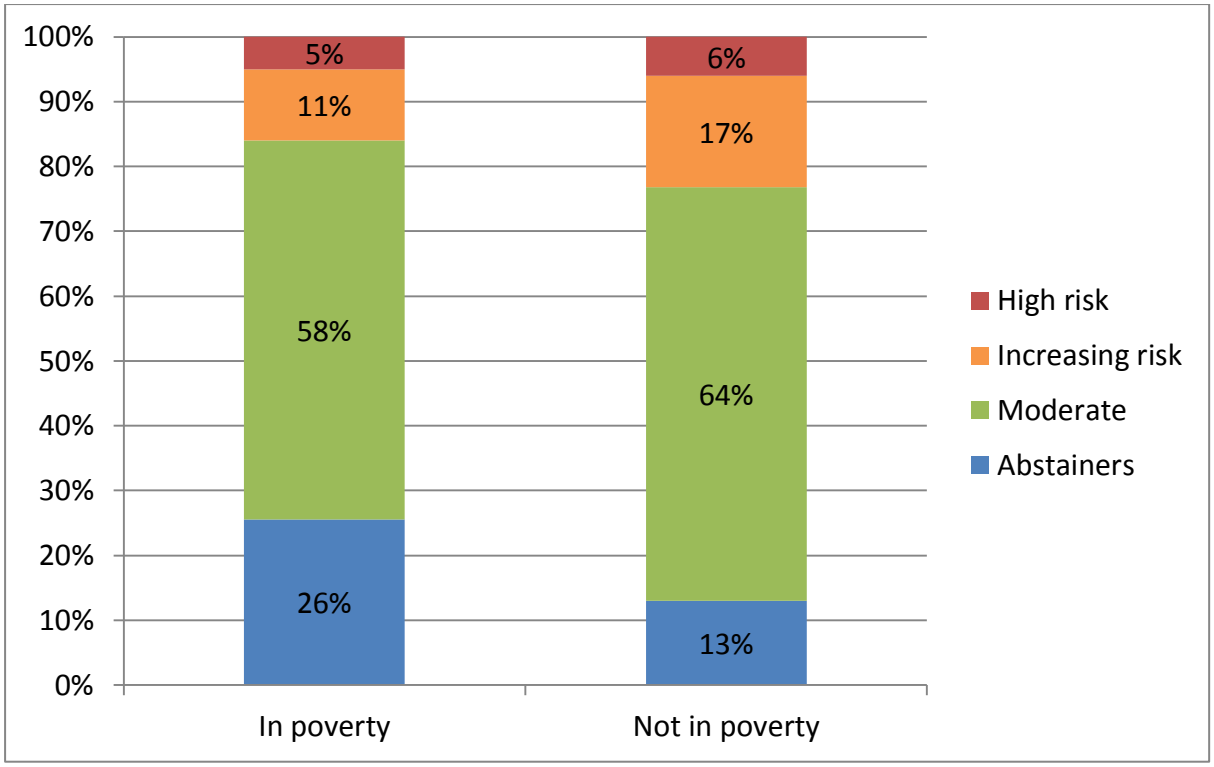


Figure 4.4: Population distribution by drinker and income group (GLF 2008-2011)

4.2.3 Patterns of consumption

In addition to mean weekly consumption of alcohol, a significant number of the harms modelled in SAPM3 are a function of intoxication; that is to say that they are related to the patterns in which alcohol is drunk, not just the overall volume consumed. In common with previous versions of SAPM we have used peak day consumption in the previous week in the GLF as a proxy measure for consumption patterns and relate the measure with wholly attributable acute health conditions, crime harms and workplace absence. Figure 4.5 and Figure 4.6 present the distribution of peak day consumption by age and gender respectively.

Apart from the peak consumption in the previous week, a new method is developed to define drinking patterns to be related to partially attributable injuries (see Section 4.3.4.3).

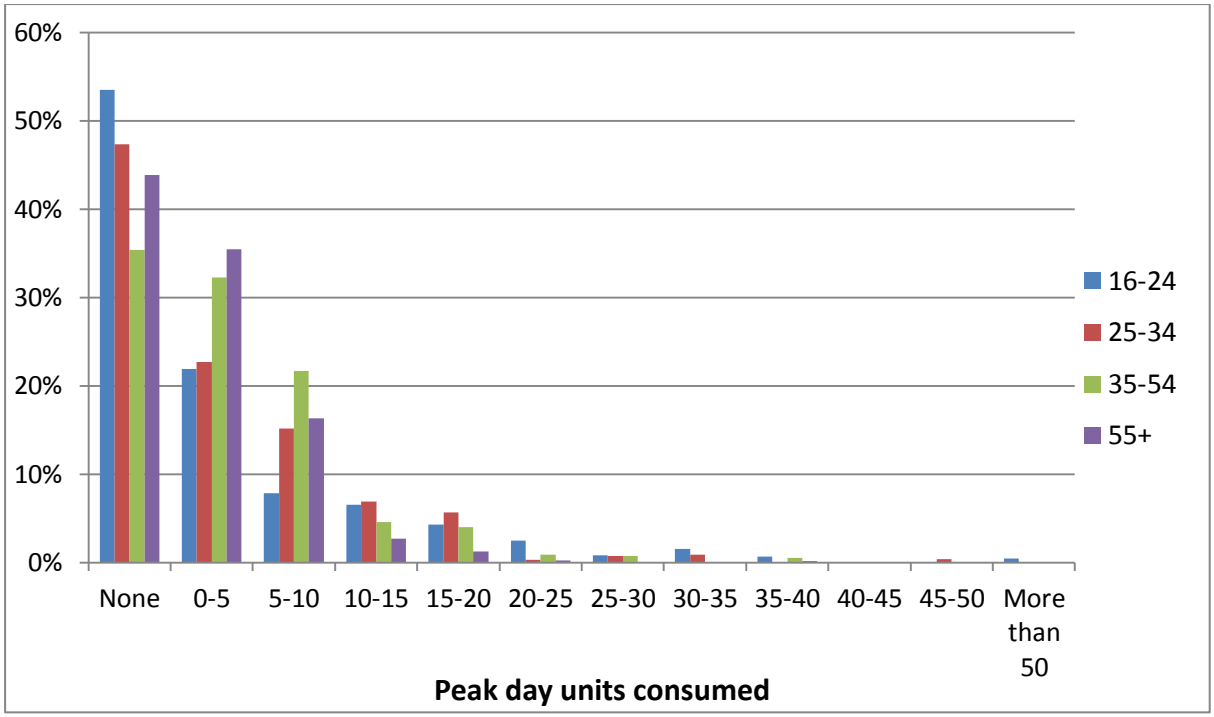


Figure 4.5: Distribution of peak day consumption by age (GLF 2008-2011)

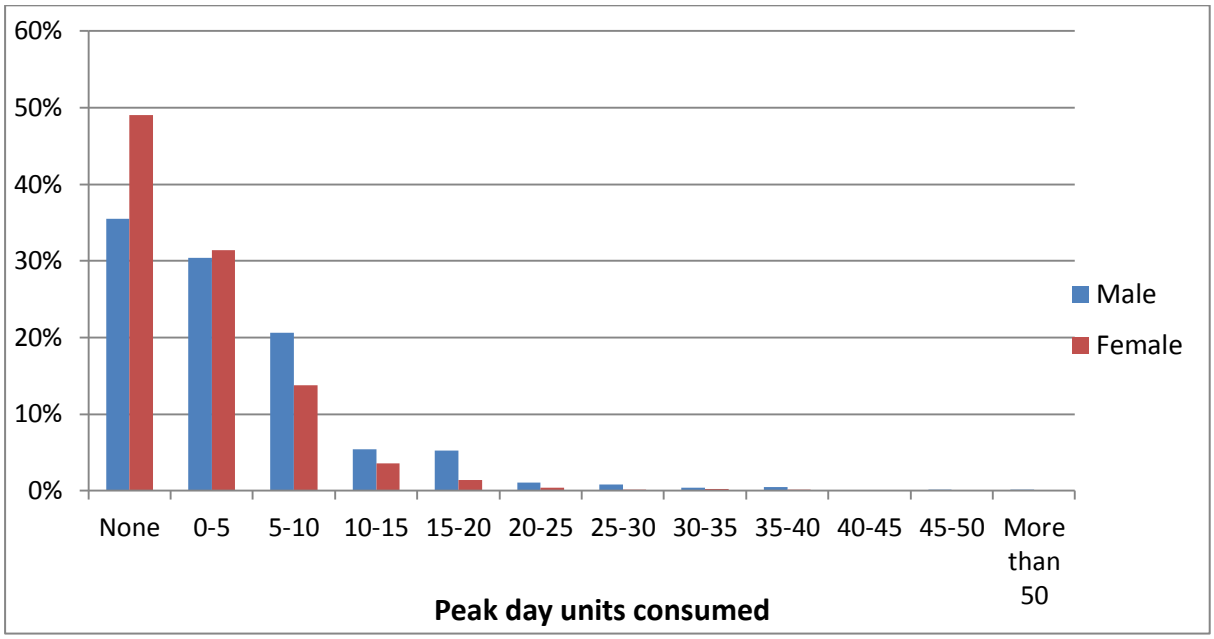


Figure 4.6: Distribution of peak day consumption by gender (GLF 2008-2011)

4.2.4 Prices

Data on the prices paid for alcohol beverages is taken from the LCF, formerly the Expenditure and Food Survey (EFS). Via a special data request to the Department for the Environment, Food and Rural Affairs (DEFRA) anonymised individual-level diary data on 25 categories of alcohol (e.g. off-trade beers, see Table 4.1 for a full list) detailing both expenditure (in pence) and quantity (in natural volume of product) were made available to the authors. All transactions from Wales for the period from 2001/2-2009 were pooled (adjusting prices for inflation using alcohol-specific RPIs (7)) to give a total sample size of 13,901 purchasing transactions. These transactions were used to construct the

baseline empirical price distributions for each modelled subgroup and each of 10 modelled beverage types including beer, cider, wine, spirits and ready-to-drink (RTD) split by off-trade and on-trade.

Table 4.1 also shows the matching of the LCF/EFS categories and the 10 modelled categories and the alcohol by volume (ABV) estimates used in the LCF 2009 for converting the natural volume of beverages to ethanol contents.

Table 4.1: Matching of LCF/EFS product categories to modelled categories and ABV estimates

LCF/EFS on /off trade	LCF/EFS category	Modelled category	ABV estimate
Off-trade	Beers	off-trade beer	3.9%
Off-trade	Lagers and continental beers	off-trade beer	3.9%
Off-trade	Ciders and Perry	off-trade cider	4.8%
Off-trade	Champagne, sparkling wines and wine with mixer	off-trade wine	11.2%
Off-trade	Table wine	off-trade wine	12.7%
Off-trade	Spirits with mixer	off-trade spirits	7.3%
Off-trade	Fortified wines	off-trade wine	14.3%
Off-trade	Spirits	off-trade spirits	39.6%
Off-trade	Liqueurs and cocktails	off-trade spirits	33.3%
Off-trade	Alcopops	off-trade RTD	4.6%
On-trade	Spirits	on-trade spirits	41.8%
On-trade	Liqueurs	on-trade spirits	29.9%
On-trade	Cocktails	on-trade spirits	13.2%
On-trade	Spirits or liqueurs with mixer	on-trade spirits	7.7%
On-trade	Wine (not sparkling) including unspecified 'wine'	on-trade wine	11.1%
On-trade	Sparkling wines and wine with mixer (e.g. Bucks Fizz)	on-trade wine	9.5%
On-trade	Fortified wine	on-trade wine	17.3%
On-trade	Cider or Perry - half pint or bottle	on-trade cider	4.8%
On-trade	Cider or Perry - pint or can or size not specified	on-trade cider	4.8%
On-trade	Alcoholic soft drinks (alcopops) and ready-mixed bottled drinks	on-trade RTDs	4.6%
On-trade	Bitter - half pint or bottle	on-trade beer	4.3%
On-trade	Bitter - pint or can or size not specified	on-trade beer	4.3%
On-trade	Lager or other beers including unspecified 'beer' - half pint or bottle	on-trade beer	5.0%
On-trade	Lager or other beers including unspecified 'beer' – pint, can or size unspecified	on-trade beer	5.0%
On-trade	Round of drinks, alcohol not otherwise specified	on-trade beer	4.8%

Sales data was available for England and Wales in 2012 from The Nielsen Company (Nielsen) by beverage type for the off-trade (8). This was used to adjust the raw price distributions for each beverage in the off-trade taken from the LCF/EFS survey for England and Wales. Welsh data were then extracted and all prices adjusted to 2014 levels using alcohol specific RPIs (7) for use in the model. This approach is perceived to give a more accurate measure of price since self-reported survey data can underestimate total purchasing. The unadjusted raw LCF/EFS price distributions and the adjusted price distributions (by Nielsen data) are illustrated in Figure 4.7 below for off-trade beer, cider, wine and spirits (RTDs are excluded as they make up a very small proportion of the market). Figure 4.7: illustrates that following adjustment, more cheap beer and less cheap cider, spirits and wine sold compared with before adjustment. Using the example of alcohol sold below 50p per unit in Wales in 2014, the estimate is 72%, 78%, 42% and 66% for off-trade beer, cider, wine and spirits using the adjusted price distributions and 67%, 91%, 54% and 75% using unadjusted price distributions.

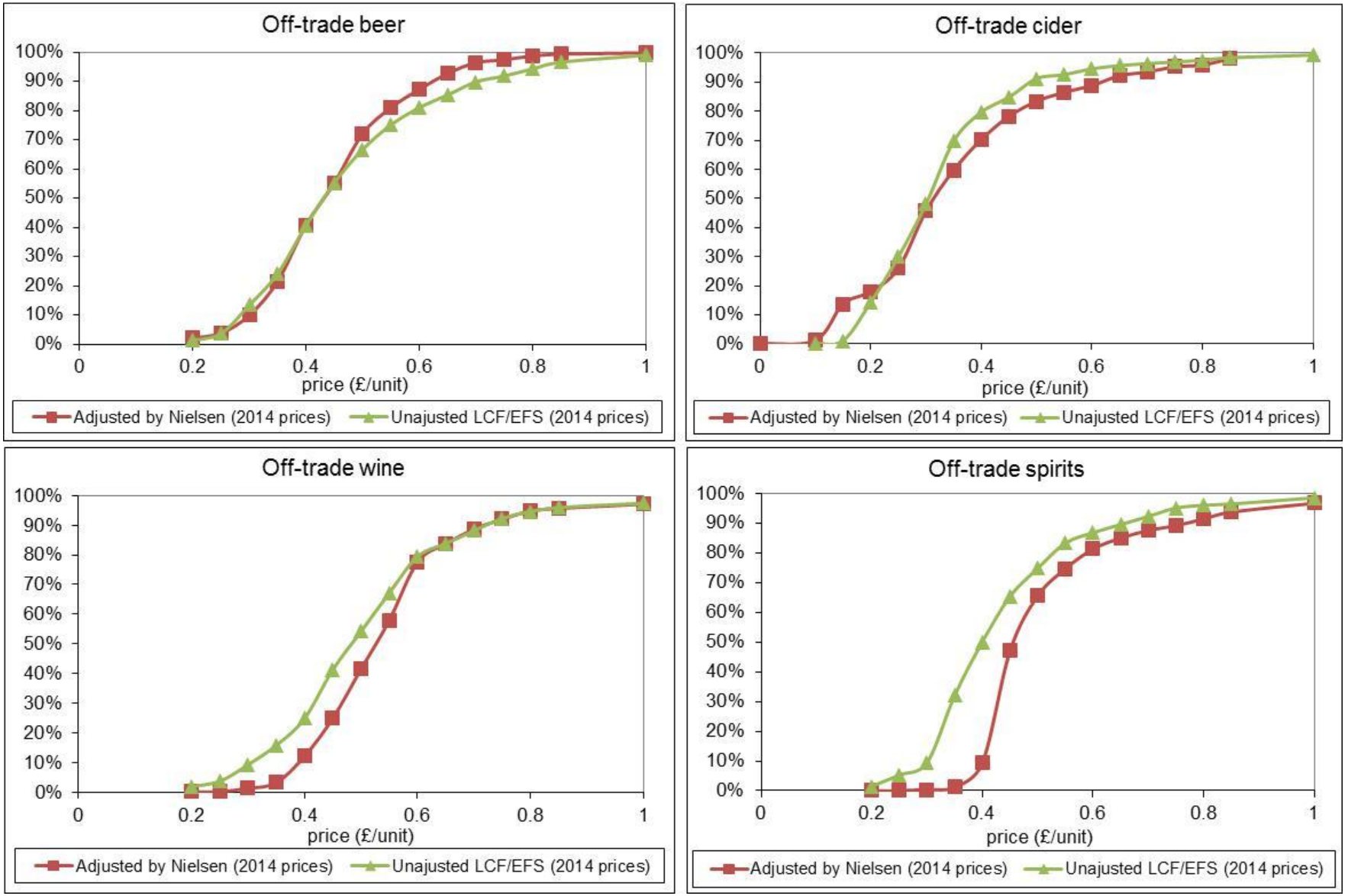


Figure 4.7: LCF/EFS (raw) and Nielsen adjusted price distributions for Welsh off-trade beverages (RTDs not shown)

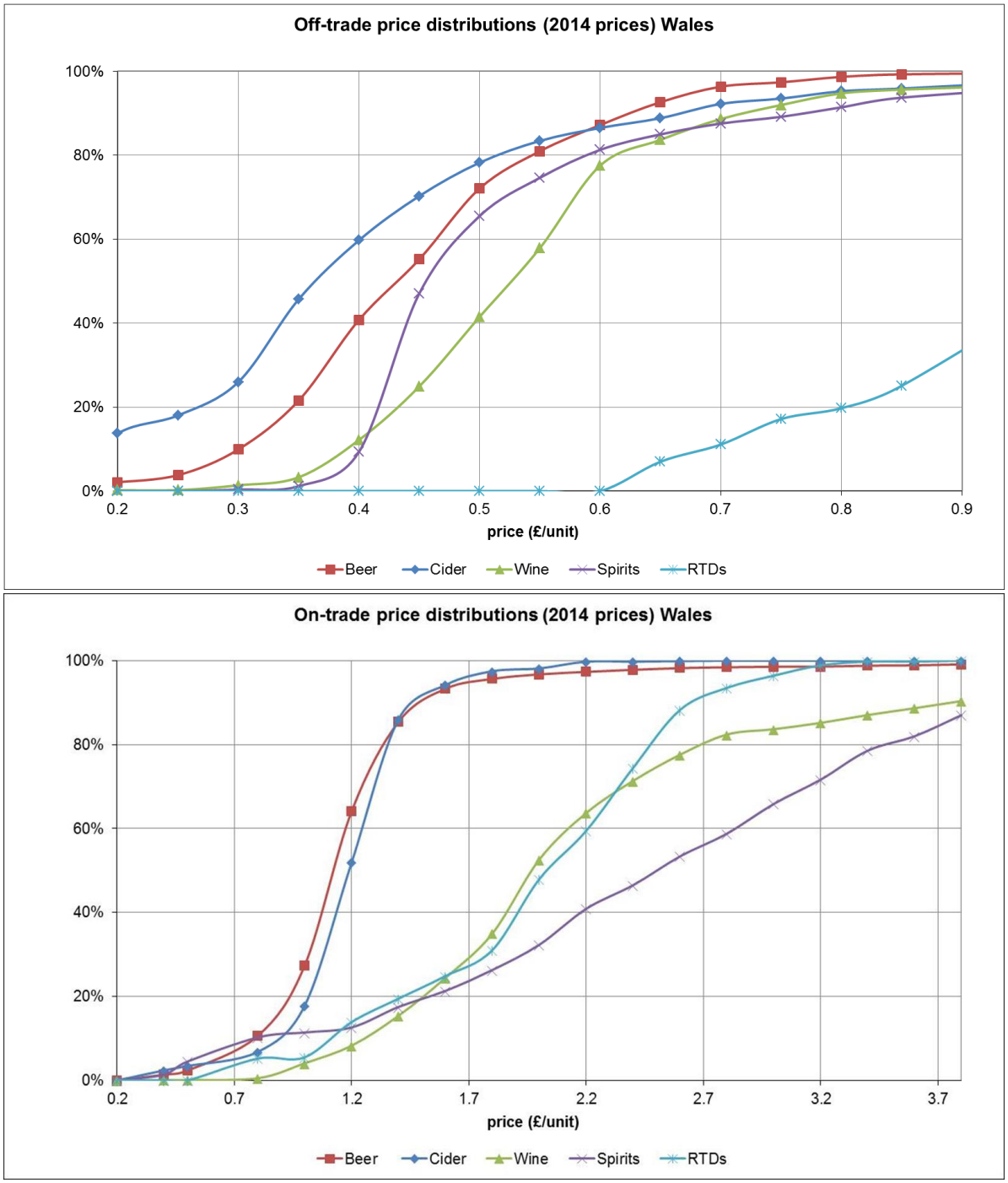


Figure 4.8: Final on- and off-trade price distributions used in SAPM3

Table 4.2 shows the proportion of alcohol within each category sold below several MUP thresholds. Although SAPM works on subgroup-specific price distributions, these figures provide an approximation of the overall proportion of alcohol within each category that would be affected by differing levels of MUP. It is apparent that these policies have a minimal impact on on-trade prices and mainly target off-trade prices; particularly for cider and beer (and, to a lesser extent, spirits).

Table 4.2: Proportion of alcohol sold in Wales below a range of MUP thresholds

	Proportions sold below thresholds (2014 prices)		
	40p	**45p**	**50p**
Off-trade beer	40.8%	55.2%	72.1%
Off-trade cider	59.7%	70.3%	78.2%
Off-trade wine	12.2%	24.9%	41.5%
Off-trade spirits	9.3%	47.0%	65.5%
Off-trade RTDs	0.0%	0.0%	0.0%
On-trade beer	1.4%	1.9%	2.4%
On-trade cider	0.0%	0.0%	3.4%
On-trade wine	0.1%	0.1%	0.1%
On-trade spirits	1.4%	2.7%	4.5%
On-trade RTDs	0.0%	0.0%	0.0%

The price data in Figure 4.7:, Figure 4.8 and Table 4.2 are for the whole population of Wales, however purchasing behaviour varies across the drinking and income spectra. Figure 4.9 shows how a 50p MUP would impact on each drinker group, stratified by those above and below the poverty line. It shows that those living in poverty purchase a greater proportion, both relatively and absolutely, of their alcohol for below 50p per unit, at each level of drinking. It also shows that high risk drinkers purchase significantly more of their alcohol below this threshold than moderate drinkers (42% vs. 21% for those below the poverty line and 28% vs. 14% for those above it). This indicates that low income drinkers will be more affected by MUP than those on higher incomes and that high risk drinkers will be more affected than moderate drinkers at all levels of income.

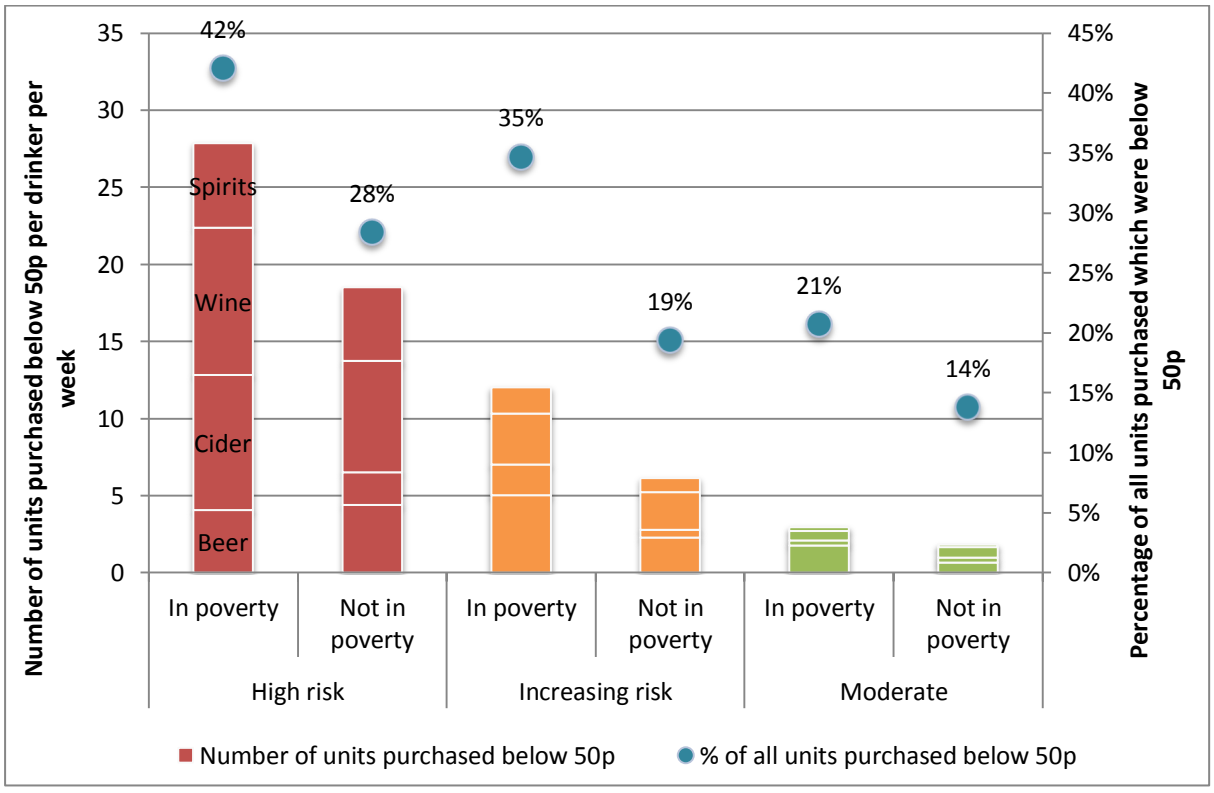


Figure 4.9: Number and proportion of units purchased at below 50p/unit by income and drinker group

Figure 4.10 illustrates how the proportion of total alcohol consumption and total spending on alcohol is attributable to each drinker group. It shows that whilst increasing and high risk drinkers combined constitute only 26% of the drinker population, they consume 72% of all alcohol and account for 65% of all spending on alcohol.

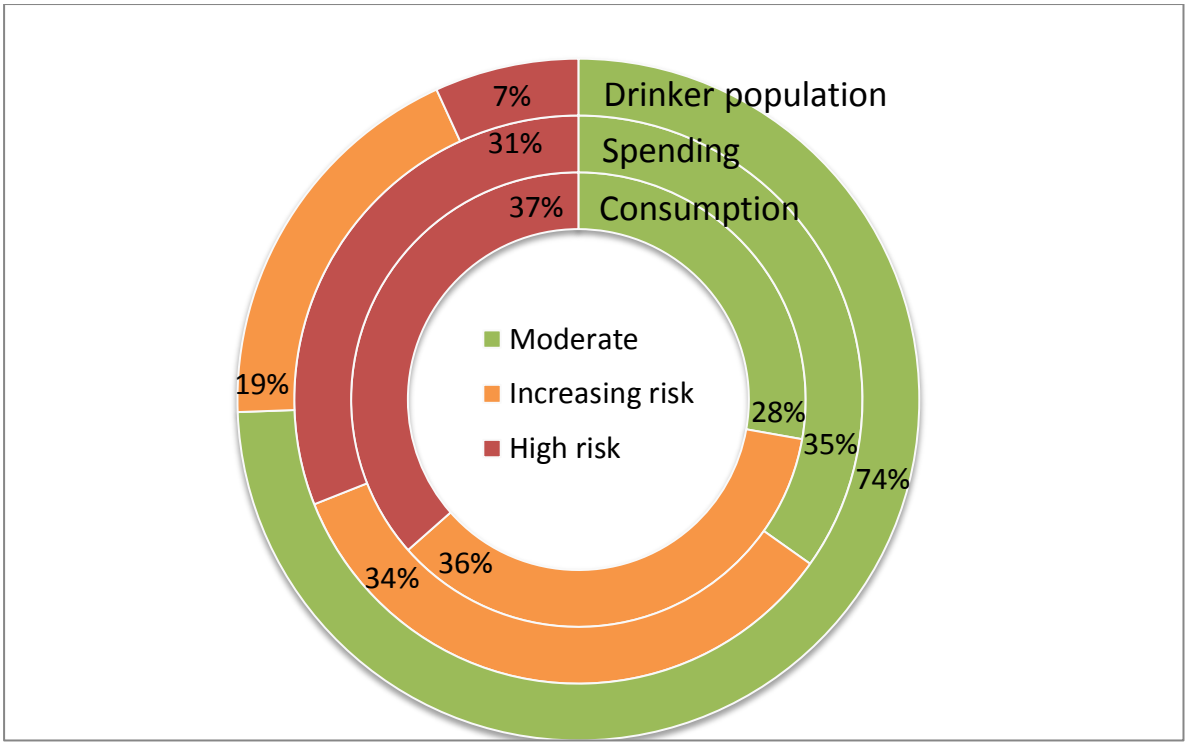


Figure 4.10: Proportion of total consumption and spending by drinker group

4.2.5 Beverage preferences

As illustrated by Figure 4.8 and Table 4.2, the impact of pricing policies will vary substantially between 10 modelled beverage categories. It is therefore crucial to capture the heterogeneity of beverage preferences between different subgroups of the population. For each individual GLF respondent their preferences for beer (including cider), wine (including sherry), spirits and RTDs are captured by the beverage-specific quantity-frequency questions which are asked in the survey. Beer and cider are then separated out using the subgroup level LCF/EFS purchasing data for that subgroup. On- and off-trade preferences for each beverage are similarly separated using the same LCF/EFS data. This produces a 10-element 'preference vector'[3] for each individual.

Figure 4.11, Figure 4.12, and Figure 4.13 show how these preferences vary across the population and some population subgroups. For example, Figure 4.11 shows that females drink more off-trade wine than males (52% of their consumption vs. 24%) and less on-trade beer (8% vs. 39%). Similarly Figure 4.12 shows that high risk drinkers drink more off-trade cider (7%) than moderate or increasing risk drinkers (3% in both cases), and moderate drinkers consumer more on-trade wine and spirits (7% combined) than increasing risk and high risk drinkers (3% and 4% respectively). Figure 4.13 shows

[3] A set of ten values describing the preference of each individual for each of the ten beverage types (% of total consumption which is contributed by consumption of that beverage).

that people in poverty drink more in the off-trade in general (67%) than those not in poverty (60%) and specifically drink more off-trade beer and cider (27%) than those not in poverty (17%).

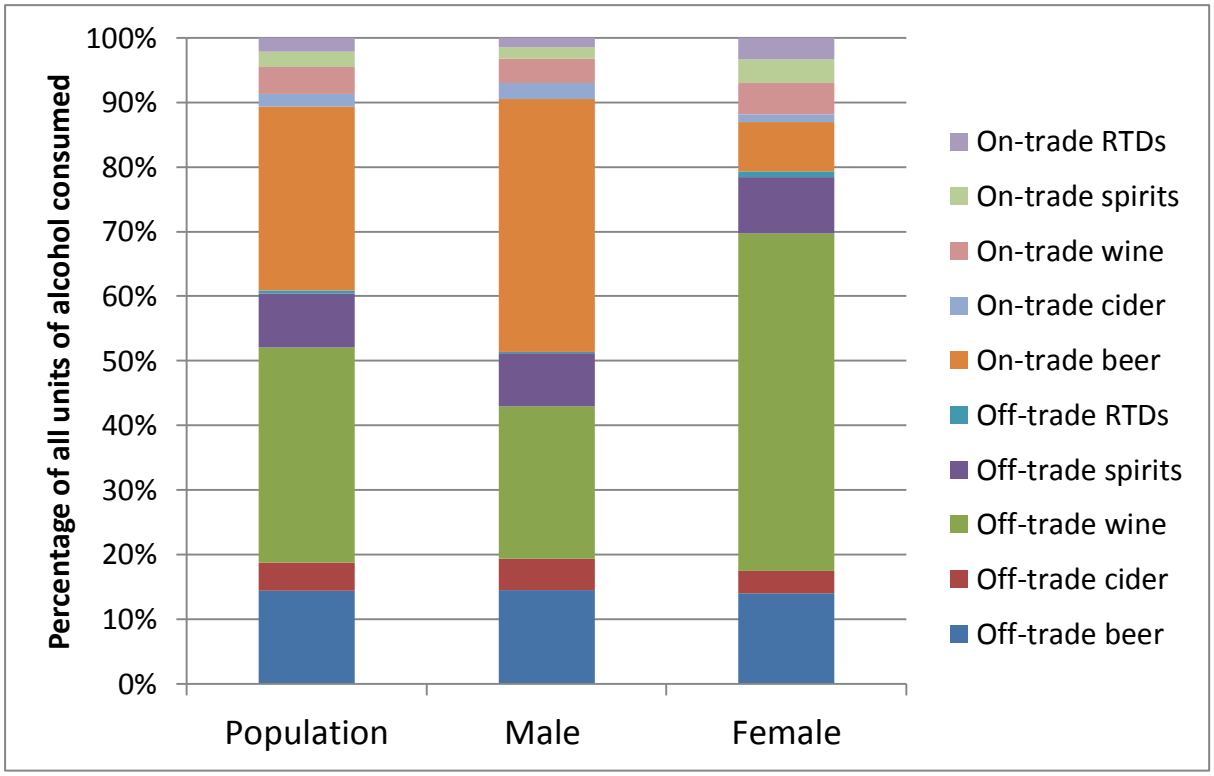


Figure 4.11: Consumption preferences by gender

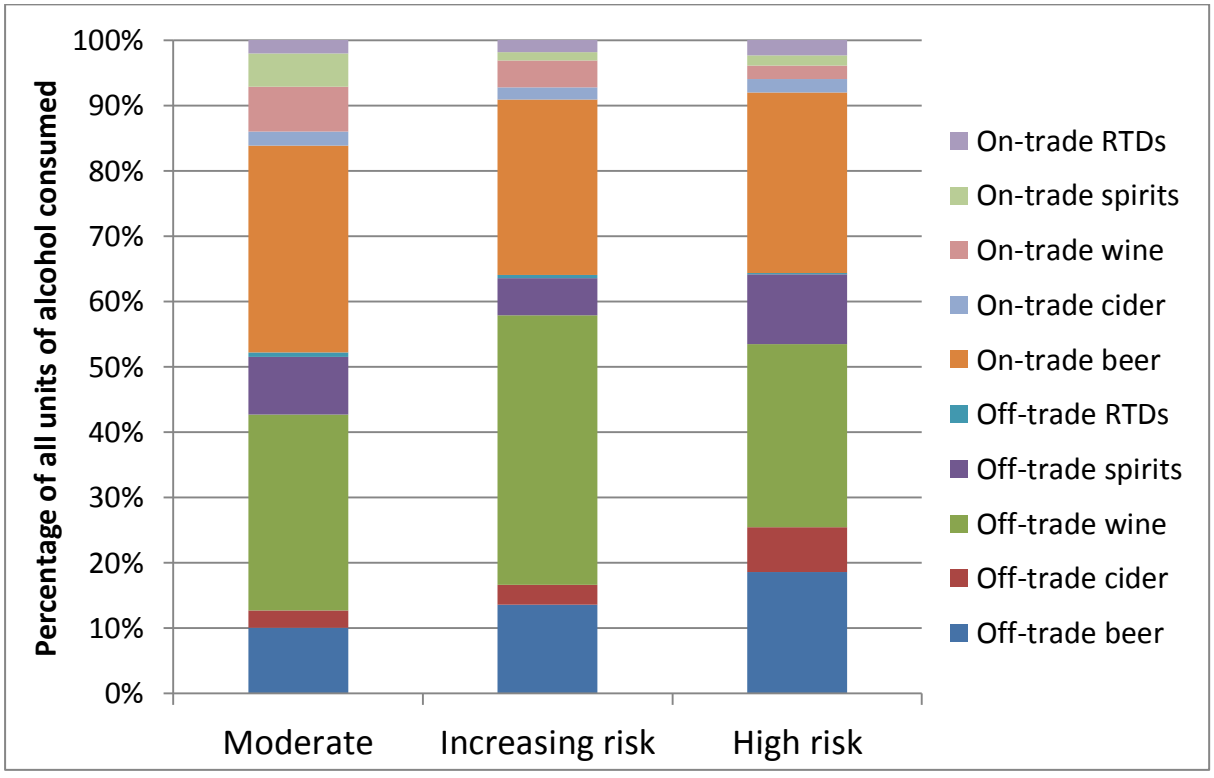


Figure 4.12: Consumption preferences by drinker group

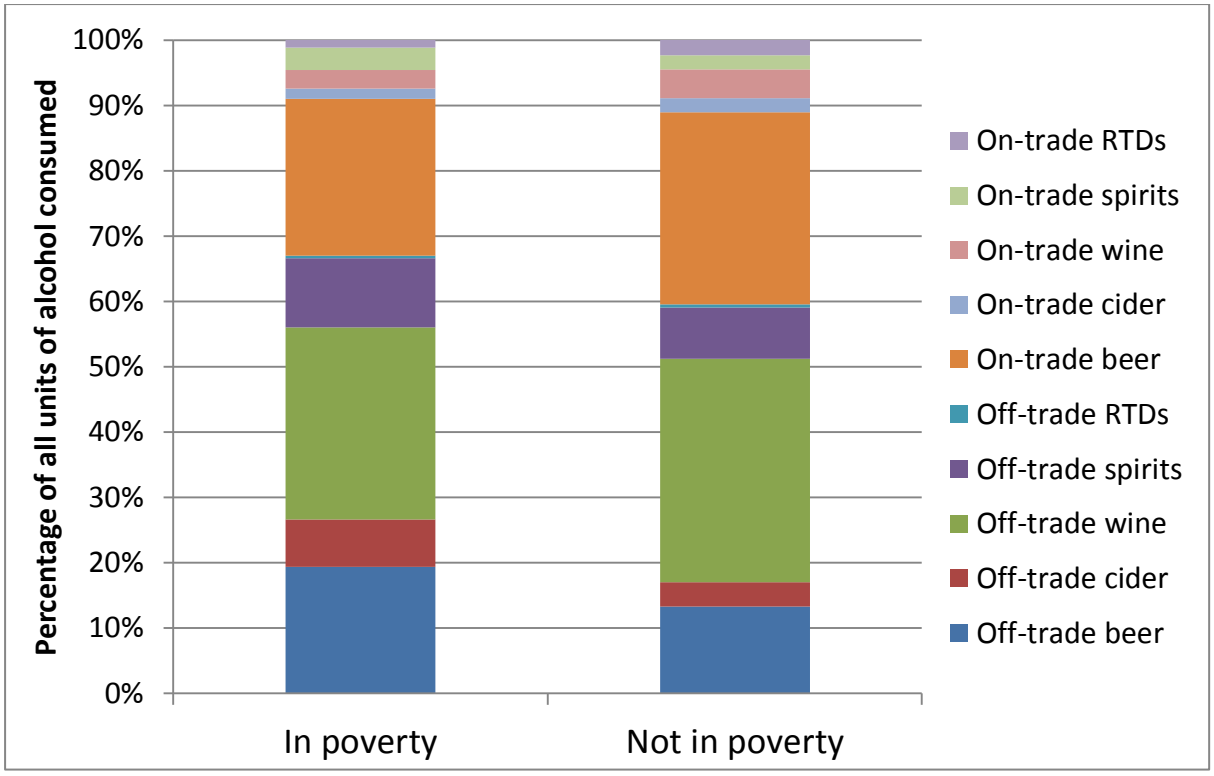


Figure 4.13: Consumption preferences by income group

4.2.6 Price elasticities of alcohol demand

The Sheffield Alcohol Research Group have recently utilised the LCF/EFS data for the whole of the UK (N=227,933 transactions) to provide new estimates of the own- and cross-price elasticities of demand for 10 types of alcohol beverages including beer, cider, spirits and RTDs separated by off- and on-trade. Price elasticities of alcohol demand represent the percentage change in alcohol demand due to a 1% change in alcohol price. Own-price elasticities indicate the percentage change in the demand for a type of alcohol due to a 1% change in the price of that same type of alcohol. Cross-price elasticities indicate the percentage change in demand for a type of alcohol due to a 1% change in the price of another type of alcohol. The sign of cross-price elasticities indicates whether the two types of alcohol of interest are substitutes (i.e. positive sign) or complements (i.e. negative sign). Full details of the elasticities model have been described elsewhere (9). The subset of the LCF/EFS dataset for Wales is too small to allow this methodology to be applied to estimate Wales-specific elasticities and therefore the whole-UK elasticities (which are estimated, in part, on Welsh data) are utilised in SAPM3.

Table 4.3 summarises the key result of this econometric analysis as a 10x10 elasticity matrix, with values on the diagonal representing own-price elasticities and remaining values representing cross-price elasticities. Elasticities are available for 10 modelled beverage categories. For example, the estimated own-price elasticity for off-trade beer is -0.98, indicating the demand for off-trade beer is estimated to reduce by 9.8% when the price of off-trade beer is increased by 10%, all other things being equal. The estimated cross-price elasticity of demand for on-trade wine with regard to off-trade beer price is 0.25, indicating the demand for on-trade wine increases by 2.5% when the price for off-trade beer is increased by 10% (i.e. a substitution effect).

Table 4.3: Estimated own- and cross-price elasticities for off- and on-trade beer, cider, wine, spirits and RTDs in the UK

		Purchase									
		Off-beer	**Off-cider**	**Off-wine**	**Off-spirits**	**Off-RTDs**	**On-beer**	**On-cider**	**On-wine**	**On-spirits**	**On-RTDs**
Price	**Off-beer**	-0.980*	-0.189	0.096	-0.368	-1.092	-0.016	-0.050	0.253	0.030	0.503
	Off-cider	0.065	-1.268*	0.118	-0.122	-0.239	-0.053	0.093	0.067	-0.108	-0.194
	Off-wine	-0.040	0.736*	-0.384*	0.363	0.039	-0.245	-0.155	0.043	-0.186	0.110
	Off-spirits	0.113	-0.024	0.163	-0.082	-0.042	0.167	0.406	0.005	0.084	0.233
	Off-RTDs	-0.047	-0.159	-0.006	0.079	-0.585*	-0.061	0.067	0.068	-0.179*	0.093
	On-beer	0.148	-0.285	0.115	-0.028	0.803	-0.786*	0.867	1.042*	1.169*	-0.117
	On-cider	-0.100	0.071	0.043	0.021	0.365	0.035	-0.591*	0.072	0.237*	0.241
	On-wine	-0.197	0.094	-0.154	-0.031	-0.093	-0.276	-0.031	-0.871*	-0.021	-0.363
	On-spirits	0.019	-0.117	-0.027	-0.280	-0.145	-0.002	-0.284	0.109	-0.890*	0.809*
	On-RTDs	0.079	0.005	-0.085	-0.047	0.369	0.121	-0.394	-0.027	-0.071	-0.187

Remarks *: p-value <0.05

4.2.7 Modelling the impact of interventions on price

In order to estimate the impact of a price-based intervention on alcohol consumption it is first necessary to estimate the effect of the policy on the beverage-specific price distributions described in Section 4.2.4. This is done by applying appropriate assumptions to the adjusted LCF/EFS transaction data as follows:

4.2.7.1 Impact of a minimum price on the price distribution

For each price observation that is below the defined minimum price threshold, the price is inflated to the level of the threshold

4.2.7.2 Impact of a ban on 'below-cost selling' on the price distribution

Below-cost selling is assumed to refer to a ban on selling any alcoholic drinks for below the cost of duty plus the VAT payable on the duty. In practical terms the policy is modelled as being equivalent to setting a minimum price equal to duty plus VAT for each beverage type (i.e. any price observations below the beverage-specific minimum price are inflated to the level of that threshold).

Table 4.4 summarises the estimated average duty plus VAT payable on the duty per unit of alcohol for beer, cider, wine, spirits and RTDs in the UK based on the current duty rates set by Her Majesty's Revenue and Customs (HMRC) effective from March 2014. A number of assumptions are used to estimate these thresholds as 1) different duty rates exist for the same modelled beverage type (e.g. there are currently three duty rates for beer which increase with alcohol content) and 2) duty rates for cider and wine are calculated based on product volume rather than ethanol content. When multiple duty rates exist (for beer, cider and wine), we choose the average duty rate as this is the duty rate which is most widely applied. The ABV assumptions for cider and wine are based on the average ABV used by HMRC (personal communication with HMRC in March 2013). The estimated duty plus VAT per unit of alcohol is 22.5p, 9.7p, 26.1p, 33.9p and 33.9p for beer, cider, wine, spirits and RTDs respectively.

Table 4.4: Method and assumptions to estimate threshold prices under BBCS - estimated duty plus VAT per unit of alcohol for beer, cider, wine, spirits and RTDs in the UK (based on duty rates from March 2014)

Beverage type	Duty rates as set by HMRC in March 2014 (£)	Assumed duty rate for SAPM3	Assumed average ABV for wine and cider	Estimated duty in pence per unit of alcohol	Estimated duty plus VAT in pence per unit of alcohol
Beer	8.62 to 24.03 per hectolitre per cent of alcohol in the beer (varies according to ABV: general - 18.74, lower strength - 8.62, higher strength - 24.03)	**18.74** per hectolitre per cent of alcohol (general duty rate)		18.74	22.49
Cider	39.66 to 264.61 per hectolitre of product (still cider - 39.66 to 59.52, sparking cider - 39.66 to 264.61)	**39.66** per hectolitre of product (still cider with ABV 1.2% to 7.5% and sparkling cider with ABV 1.2% to 5.5%)	4.90%	8.09	9.71
Wine	84.21 to 364.37 per hectolitre of product (wine, still wine and made wine - 84.21 to 364.37, sparkling wine and made wine - 264.61 to 350.07) or 28.22 per litre of pure alcohol (wine with ABV > 22%)	**273.31** per hectolitre of product (still wine with ABV 5.5% to 15%)	12.58%	21.73	26.07
Spirits	28.22 per hectolitre of pure alcohol	**28.22** per hectolitre of pure alcohol		28.22	33.86
RTDs	28.22 per hectolitre of pure alcohol (spirits based)	**28.22** per hectolitre of pure alcohol (spirits based)		28.22	33.86

4.2.8 Modelling the impact of price on consumption

After adjusting the price distributions, the final step to estimating the impact of the intervention on alcohol consumption is to apply the price elasticities. For each modelled subgroup the impact of the change in prices caused by the policy on mean weekly alcohol consumption is estimated using the elasticity matrix described in Table 4.3. The formula used to apply the elasticity matrix is shown below:

$$\%\Delta C_i = \left(1 + e_{ii}\%\Delta p_i\right)\left(1 + \sum_{j \neq i}^{\forall j} e_{ij}\%\Delta p_j\right) - 1 \qquad \textit{Equation 1}$$

Where, $\%\Delta C_i$ is the estimated percentage change in consumption for beverage *i*, e_{ii} is the own-price elasticity for beverage *i*, $\%\Delta p_i$ is the percentage change in price for beverage *i*, e_{ij} is the cross-price elasticities for the consumption of beverage *i* due to a change in the price of beverage *j*, and $\%\Delta p_j$ is the percentage change in price for beverage *j*.

Some types of modelled alcohol-related harms such as crime and absenteeism are assumed to be linked to peak day consumption. Therefore, the changes in peak day consumption also needed to be estimated. A statistical regression model was built to map the scale of peak consumption from the mean consumption. As in previous analysis, regression models are built separately for moderate, increasing risk and high risk drinkers and the coefficients are presented in Table 4.6.

Table 4.5: Statistical regression model - relationship between the scale of the binge and the mean daily consumption

	IF (Moderate)	IF (Increasing risk)	IF (High risk)
peak day consumption (units) =	(mean daily intake (units) * 2.652306) + 0.4027226 + …	(mean daily intake (units) * 0.2393311) + 2.092927 + …	(mean daily intake (units) * 0.5544984) + 28.66303 + …
male aged 16-17	0*	0*	0*
male aged 18 – 24	1.29313	5.167068	-6.700918
male aged 25 – 34	1.262032	4.680034	-19.20179
male aged 35 – 44	0.6099386	8.24516	-18.58991
male aged 45 – 54	0.0470491	7.415667	-19.89739
male aged 55 – 64	0.9623411	3.520434	-25.02954
male aged 65 – 74	-0.4496809	1.467759	-25.89059
male aged 75 +	-0.8420379	0.4331094	-25.60081
female aged 16 – 17	0.3560654	-0.516557	-32.90652
female aged 18 – 24	0.2206104	5.339945	-5.459515
female aged 25 – 34	-0.001116	7.536069	-20.0198
female aged 35 – 44	0.3491424	2.841193	-28.00208
female aged 45 – 54	0.5279602	3.050742	-23.90071
female aged 55 – 64	-0.0506759	2.422194	-24.74409
female aged 65 – 74	-0.1371912	1.006685	-24.11624
female aged 75 +	-0.4978893	0*	-27.09902
R-Squared	0.3253	0.1929	0.4506
Adjusted R-Squared	0.3187	0.1551	0.3661
Root MSE	3.0735	5.2488	8.566

**Omitted dummy variables: in these three linear regression models peak consumption is regressed against mean daily consumption with a dummy variable for each age-gender category (the dummy variable is 1 or 0, where 1 indicates group membership). In each case, one dummy variable from the set is omitted (males aged 16-17) to avoid multicollinearity between dummies (where one variable can be explained by one or more of the others). The regression constant represents the intercept for the omitted dummy variable and each of the other dummies has its own intercept. In the model for increasing risk drinkers, the dummy for females aged 75+ was omitted by the modelling software (Stata) because of collinearity (probably due to the small sample size of 4 in this sub-group). This means that in SAPM, females aged over 75 in the increasing risk category would have binge drinking calculated in the same way as males aged 16-17 (i.e. 0.24 multiplied by their mean daily consumption plus 2.1 units).*

4.3 MODELLING THE RELATIONSHIP BETWEEN CONSUMPTION AND HARM

4.3.1 Model structure

An epidemiological approach is used to model the relationship between consumption and harm, relating changes in the prevalence of alcohol consumption to changes in prevalence of risk of experiencing harmful outcomes. Risk functions relating consumption (however described) to level of risk are a fundamental component of the model.

The 'consumption to harm' model considers the impact of consumption on harms in three domains: health (including the impact on both mortality and morbidity), crime and the workplace.

4.3.2 Alcohol-related health conditions

The model aims to capture the policy impact for the large number of health conditions for which evidence suggests alcohol plays a contributory role. Table 4.6 presents a list of all included conditions, which has been adapted from recent global meta-analyses and burden of disease studies (10, 11). These conditions are divided into four categories of attribution:

1) Wholly attributable chronic – meaning that the harm cannot occur in the absence of alcohol consumption, and risk of occurrence changes with chronic exposure to alcohol (e.g. alcoholic liver disease, ICD10 code = K70).
2) Wholly attributable acute – meaning that the harm cannot occur without alcohol as its cause, and risk of occurrence changes with acute exposure to alcohol including intoxication (e.g. Ethanol poisoning, ICD10 code = T51.0).
3) Partially attributable diseases – meaning that the harm can occur without alcohol but the risk of occurrence changes with chronic exposure to alcohol (e.g. malignant neoplasm (cancer) of the oesophagus, ICD10 code = C15). There are three conditions within this category – ischaemic heart disease, ischaemic stroke and type II diabetes – in which alcohol may have an overall protection effect.
4) Partially attributable injuries – meaning that the harm can occur without alcohol but the risk of occurrence changes with acute exposure to alcohol (e.g. falls, ICD10 code = W00-W19, or assault, ICD10 = X85-Y09).

Table 4.6: Health conditions included in the model

Main category	Sub category	Disease or injury	ICD-10 codes	Source of dose-response relative risk functions
Wholly attributable to alcohol (17)	Chronic (10)	Alcohol-induced pseudo-Cushing's syndrome	E24.4	By definition AAF=1 and no defined relative risk functions
		Degeneration	G31.2	
		Alcoholic polyneuropathy	G62.1	
		Alcoholic myopathy	G72.1	
		Alcoholic cardiomyopathy	I42.6	
		Alcoholic gastritis	K29.2	
		Alcoholic liver disease	K70.0-K70.4, K70.9	
		Acute pancreatitis (alcohol induced)	K85.2	
		Chronic pancreatitis (alcohol induced)	K86.0	
		Maternal care for (suspected) damage to foetus from alcohol	O35.4	
	Acute (7)	Mental and behavioural disorders due to use of alcohol	F10	
		Excessive Blood Level of Alcohol	R78.0	
		Toxic effect of alcohol	T51.0, T51.1, T51.8, T51.9	
		Accidental poisoning by exposure to alcohol	X45	
		Intentional self-poisoning by and exposure to alcohol	X65	
		Poisoning by and exposure to alcohol, undetermined intent	Y15	
		Evidence of alcohol involvement determined by blood alcohol level	Y90	
Partially attributable to alcohol (23)	Diseases (overall detrimental) (14)	Tuberculosis	A15-A19, B90	Lonnroth *et al* 2008[12*]
		Malignant neoplasm of lip, oral cavity and pharynx	C00-C14	Tramacere *et al* 2010[13]
		Malignant neoplasm of oesophagus	C15	Rota *et al* 2009[14]
		Malignant neoplasm of colon and rectum	C18-C21	Fedirko *et a*l 2011[15]
		Malignant neoplasm of liver and intrahepatic bile ducts	C22	Corrao *et al* 2004[16]
		Malignant neoplasm of larynx	C32	Islami *et al* 2010[17]
		Malignant neoplasm of breast	C50	Key *et al* 2006[18]
		Epilepsy and status epilepticus	G40-G41	Samokhvalov *et al* 2010[19]
		Hypertensive diseases	I10-I14	Taylor *et al* 2009[20]
		Cardiac arrhythmias	I47-I48	Kodama *et al* 2011[21]
		haemorrhagic and other non-ischaemic stroke	I60-I62, I69.0-I69.2	Patra *et al* 2010[22†]
		Lower respiratory infections: pneumonia	J09-J22, J85, P23	Samokhvalov *et al* 2010[23†]
		Cirrhosis of the liver (excluding alcoholic liver disease)	K70 (excl. K70.0-K70.4, K70.9), K73-K74	Rehm *et al* 2010[24]
		Acute and chronic pancreatitis	K85-K86 excl. K85.2, K86.0	Irving *et al* 2009[25]
	Injuries (9)	Transport injuries (including road traffic accidents)	V01-V98, Y85.0	Taylor *et al* 2011[26]
		Fall injuries	W00-W19	
		Exposure to mechanical forces (including machinery accidents)	W20-W52	
		Drowning	W65-W74	
		Other Unintentional Injuries	W75-W99, X30-X33, X50-X58	
		Accidental poisoning by exposure to noxious substances	X40-X49 excl. X45	
		Intentional self-harm	X60-X84, Y87.0 excl. X65	
		Assault	X85-Y09, Y87.1	
		Other intentional injuries	Y35	
Diseases (overall beneficial) (3)		Diabetes mellitus (type II)	E10-E14	Baliunas *et al* 2009[27]
		Ischaemic heart disease	I20-I25	Roerecke and Rehm 2012[28]
		Ischaemic stroke	I63-I67, I69.3	Patra *et al* 2010[22†]

4.3.3 Alcohol-attributable fractions and potential impact fractions

The methodology is similar to that used in Gunning-Scheper's Prevent model (29), being based on the notion of the alcohol-attributable fraction (AAF) and its more general form, the potential impact fraction (PIF).

The AAF of a disease can be defined as the difference between the overall average risk (or incidence rate) of the disease in the entire population (drinkers and never-drinkers) and the average risk in those without the exposure factor under investigation (never-drinkers), expressed as a fraction of the overall average risk. For example, the AAF for female breast cancer is simply the risk of breast cancer in the total female population minus the risk of breast cancer in women who have never consumed alcohol, divided by the breast cancer risk for the total female population. Thus, AAFs are used as a measure of the proportion of the disease that is attributable to alcohol. While this approach has traditionally been used for chronic health-related outcomes, it can in principle be applied to other harms (including those outside of the health domain).

The AAF can be calculated using the following formula:

$$AF = \frac{\sum_{i=1}^{n} p_i \left(RR_i - 1\right)}{1 + \sum_{i=1}^{n} p_i \left(RR_i - 1\right)}$$

Equation 2

where, *RRi* is the relative risk (RR) due to exposure to alcohol at consumption state *i*, *pi* is the proportion of the population exposed to alcohol at consumption state *i*, and *n* is the number of consumption states.

If the reference category is abstention from alcohol then the AAF describes the proportion of outcomes that would not have occurred if everyone in the population had abstained from drinking. Thus the numerator is essentially the excess expected cases due to alcohol exposure and the denominator is the total expected cases. In situations where certain levels of alcohol consumption reduce the risk of an outcome (e.g. coronary heart disease) the AAF can be negative and would describe the additional cases that would have occurred if everyone was an abstainer.

Note that there are methodological difficulties with AAF studies. One problem is in defining the non-exposed group – in one sense 'never drinkers' are the only correct non-exposed group, but they are rare and usually quite different from the general population in various respects. However, current non-drinkers include those who were heavy drinkers in the past (and these remain a high-risk group, especially if they have given up due to alcohol-related health problems). Several studies show that findings of avoided coronary heart disease risk may be based on systematic errors in the way abstainers were defined in the underlying studies (30).

The PIF is a generalisation of the AAF based on arbitrary changes to the prevalence of alcohol consumption (rather than assuming all drinkers become abstainers). Note that a lag may exist between the exposure to alcohol and the resulting change in risk. The PIF can be calculated using the following formula:

$$PIF = 1 - \frac{\sum_{i=0}^{n} \overline{p_i} RR_i}{\sum_{i=0}^{n} p_i RR_i}$$

Equation 3

where $\overline{p_i}$ is the modified prevalence for consumption state *i* and state 0 corresponds to abstention. In the model, alcohol consumption in a population subgroup is described non-parametrically by the associated observations from Welsh sample in the GLF. For any harmful outcome, risk levels are associated with consumption level for each of the observations (note that these are not person-level risk functions). The associated prevalence for the observation is simply defined by its sample weight from the survey. Therefore, the PIF is implemented in the model as:

$$PIF = 1 - \frac{\sum_{i=0}^{N} w_i \overline{RR_i}}{\sum_{i=0}^{N} w_i RR_i}$$

Equation 4

where w_i is the weight for observation *i*, $\overline{RR_i}$ is the modified risk for the new consumption level and *N* is the number of samples.

4.3.4 Applying potential impact fractions

The impact of a change in consumption on health harms was examined using the potential impact fraction framework and by three different methods for implementation:

1. Direct application of consumption measures to calculate potential impact fractions for wholly attributable chronic and acute conditions.
2. Relative risk functions from the published literature for partial attributable chronic diseases.
3. Relative risk functions from the published literature and derived individual annualised risk for partial attributable injuries.

4.3.4.1 Wholly attributable chronic and acute conditions

Wholly attributable chronic and acute conditions, by definition, have an AAF=1 and no relative risk function can be defined since the reference group has no risk. In order to apply the potential impact fraction, relative risk in Equation 4 is replaced with alcohol consumption that is likely to lead to increased risk for the health condition, denoted by $RiskAlc_i$. For wholly attributable chronic conditions, $RiskAlc_i$ is defined as the difference between mean daily consumption and recommended daily consumption in the UK (3/2 units for men/women) or 0 if mean daily consumption is below the threshold. For wholly attributable acute conditions, $RiskAlc_i$ is defined the difference between peak day consumption and the cut-off thresholds of 4/3 units for men/women at which we assume the acute risk starts to increase or 0 if peak day consumption is below the threshold (1).

4.3.4.2 Partially attributable chronic conditions

The relative risk functions for all chronic conditions that are partially attributable to alcohol are taken from published meta-analyses and used in Equation 4. Table 4.6 gives the sources for these risk functions.

4.3.4.3 Partially attributable acute conditions

Partially attributable acute conditions include various traffic and non-traffic injuries. The identified relative risk functions for these conditions are different from the relative risk functions for partially attributable chronic conditions and cannot be used directly in Equation 4. The input and outcome of the relative risk functions for partially attributable chronic conditions are usual alcohol consumption and relative risk over a certain period of time, however, the input and outcome of the identified relative risk functions for traffic and non-traffic injuries are levels of drinking on the occasion prior to the injury and the relative risk for the drinking occasion (26). As SAPM3 works on annual cycles, relative risk in Equation 4 is defined as annual relative risk. Therefore, to apply Equation 4, single drinking occasion based relative risk needs to be converted to long term (e.g. annual) relative risk of a surveyed individual.

A new method to estimate annualised relative risk of alcohol-attributable traffic- and non-traffic injuries has been developed. Briefly, three measures are defined to represent drinking pattern based on single drinking occasions which are the frequency of drinking occasions (defined as n, or number of drinking occasions per week), mean level of alcohol consumption for a given drinking occasion (defined as μ, or units of alcohol) and the variability of alcohol consumption for a given drinking occasion (defined as σ, or standard deviation of units of alcohol consumed in drinking occasions). Using the ONS' National Diet and Nutrition Survey (NDNS), regression models were fitted to relate the three measures with mean consumption and a range of independent variables (e.g. age, gender, education, ethnicity, etc.) (31). These regression models are used to impute the three measures for each individual in the Welsh sample of GLF. For each individual, alcohol consumption in a given drinking occasion is assumed to follow a normal distribution with mean of μ and standard deviation of σ; and the duration of intoxication for a given drinking occasion is calculated by applying the equation for estimating blood alcohol content. Finally, a series of integration was performed to calculate the annualised relative risk for traffic and non-traffic accidents. Detailed description of the method can be found elsewhere (31). The annualised relative risk is used in Equation 4 to estimate the potential impact factor for partially attributable acute conditions.

4.4 CONSUMPTION TO HEALTH HARMS MODEL

4.4.1 Mortality model structure

A simplified version of the model structure for mortality is presented in Figure 4.14. The model is developed to represent the population of Wales in a life table. Separate life tables have been implemented for males and females.

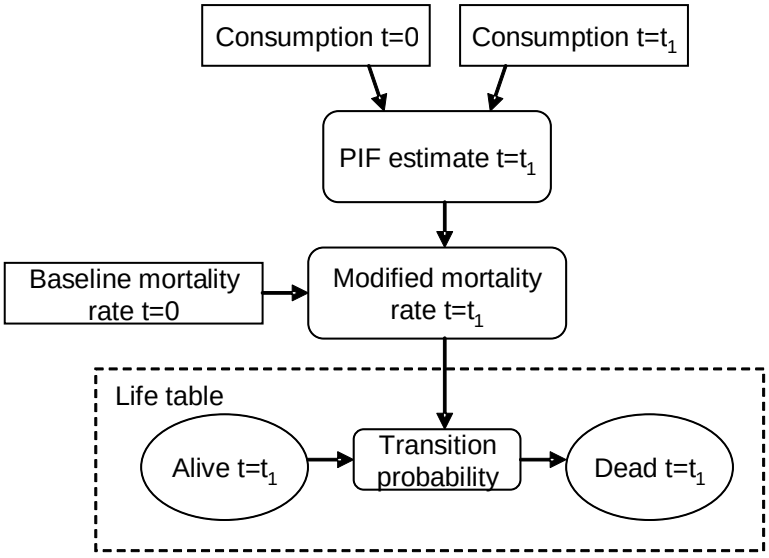


Figure 4.14: Simplified structure of the mortality model

The life table is implemented as a linked set of simple Markov[4] models with individuals of age *a* transitioning between two states – alive and dead – at model time step *t*. Those of age *a* still alive after the transition then form the initial population for age *a+1* at time *t+1* and the sequence repeats.

The transition probabilities from the alive to dead state are broken down by condition and are individually modified via potential impact fractions over time t, where the PIF essentially varies with consumption over time:

$$PIF_t = 1 - \frac{\sum_{i=1}^{N} RR_{i,t} w_i}{\sum_{i=1}^{N} RR_{i,0} w_i} \qquad \textit{Equation 5}$$

where PIF_t is the potential impact fraction relating to consumption at time *t*, *i* = GLF sample number, *N* = number of samples in subgroup *i*, $RR_{i,t}$ is the risk relating to the consumption of GLF sample *i* at time *t*, $RR_{i,0}$ is the risk at baseline, and w_i is the weight of sample *i*.

Note that the PIF can be decomposed to enable different population groups at baseline – for example, moderate, increasing risk and high risk drinkers or individuals in poverty and not in poverty– to be followed separately over the course of the model.

The model computes mortality results for two separate scenarios (a baseline – implemented as 'no change to consumption' in the analysis herein – and an intervention). The effect of the intervention is then calculated as the difference between the life tables of two scenarios, enabling the change in the total expected deaths attributable to alcohol due to the policy to be estimated.

[4] A state transition model where individuals can exist in a set number of states at any time period and transition between states using a set of transition probabilities which are conditional on the current state of the individual.

Outcomes from the mortality modelling are expressed in terms of life years saved. Morbidity valuation is the purpose of a second model described below.

4.4.2 Morbidity model structure

A simplified schematic of the morbidity model is shown in Figure 4.15. The model focuses on the expected disease prevalence for population cohorts. Note that if an incidence-based approach were used instead, then much more detailed modelling of survival time, cure rates, death rates and possibly disease progression for each disease for each population subgroup would be required.

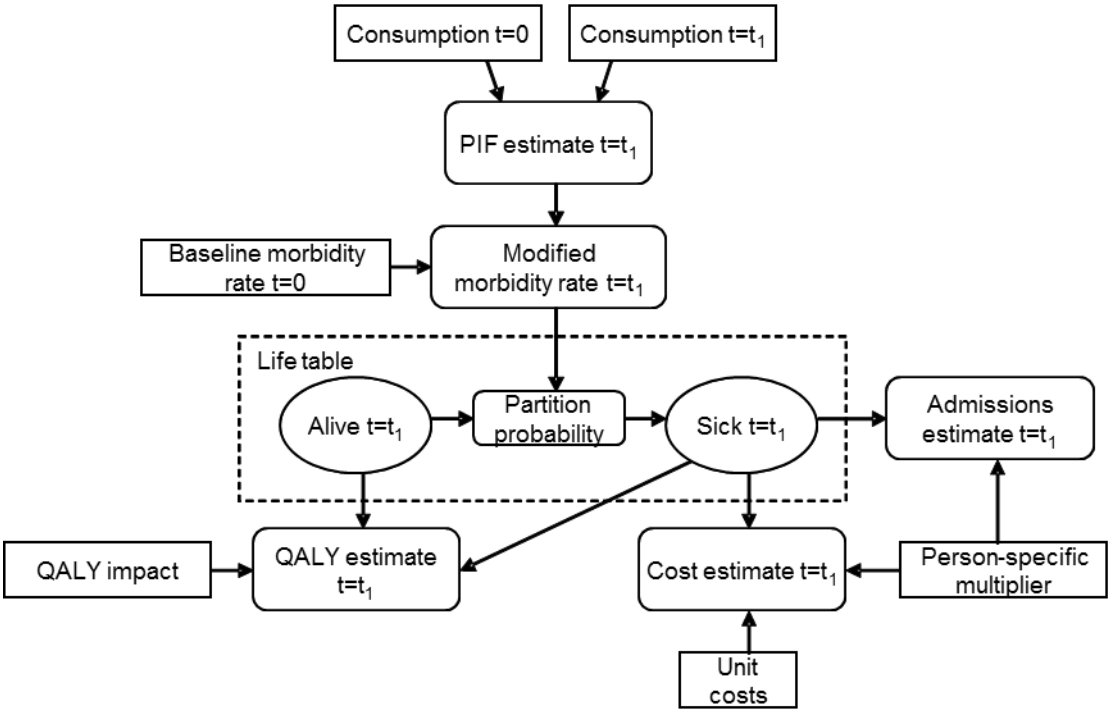


Figure 4.15: Simplified structure of the morbidity model

The morbidity model works by partitioning the alive population at time *t*, rather than using a transition approach between states as previously described for the mortality model. Alive individuals are partitioned between all 48 alcohol-related conditions (and a 49th condition representing overall population health, not attributable to alcohol).

As in the mortality model, the PIF is calculated based on the consumption distribution at time *0* and *t*. The PIF is then used to modify the partition rate (i.e. the distribution of the 48 conditions for alive individuals) to produce person-specific sickness volumes. These volumes then form the basis for estimating both health service costs and health related quality of life.

Quality Adjusted Life Years (QALYs) are examined using the difference in health-related quality of life (utility) in individuals with alcohol health harms and the quality of life measured in the general population (or "normal health"). Utility scores usually range between 1 (perfect health) and 0 (a state equivalent to death), though it is possible for some extreme conditions to be valued as worse than death. The utility scores are an expression of societal preference for health states with several different methods available to estimate them. Note that because a life table approach has been

adopted, the method to estimate QALY change for morbidity also encompasses the mortality valuation.

4.4.3 Time lag effects for chronic harms

When modelling the link between consumption and harm, one important input is the assumption surrounding the 'time lag' – the time needed to achieve the full benefit (reduction in harms) associated with a reduction of consumption. Such data is necessary for chronic conditions where the development of diseases often occurs over many years.

Following a recent systematic review by members of the Sheffield Alcohol Research Group (32), SAPM3 incorporates new lag structures for all chronic harms based on the best available published evidence to estimate the temporal relationship between changes in consumption and changes in risk of harm. See Table 2 in Holmes et al. (32) for full details of these relationships as implemented in the model.

4.4.4 Mortality model parameters

Baseline population data, used to populate the initial life tables for Wales was obtained from the Office for National Statistics' (ONS) mid-year population estimates for 2012. Age and gender subgroup-specific mortality rates for each of the 48 modelled health conditions as well as all-cause mortality were calculated from data supplied by the NHS Wales Information Service (NWIS) for 2010-2012. Deprivation level (by quintile from the Welsh Index for Multiple Deprivation - WIMD) was also provided within the mortality data. Mortality rates for the most deprived quintile and the higher four quintiles are used as proxy for the mortality rates for people who live below and above the poverty line, respectively. It is worth noting that deprivation is not an exact match for poverty. WIMD is a measure of multiple deprivation based partially on income but also on employment, health, education, geographical access to services, community safety, physical environment and housing. In our sample for consumption data, 24% were recorded as below the poverty line, whereas the lowest quintile of deprivation in the mortality and morbidity data comprised 20% of the population. Table 4.7 summarises the mortality rates in Wales by gender, age and income groups for each modelled health condition. Note that there have been no recorded deaths in the sample years 2010-2012 for the following health conditions: alcohol-induced pseudo-Cushing's syndrome, alcoholic polyneuropathy, alcoholic myopathy, maternal care for (suspected) damage to foetus from alcohol, excessive blood level of alcohol, toxic effect of alcohol, intentional self-poisoning by and exposure to alcohol, poisoning by and exposure to alcohol, undetermined intent, evidence of alcohol involvement determined by blood alcohol level, other intentional Injuries.

Table 4.7: Mortality rates per 100,000 population in Wales by gender, age and income groups for modelled health conditions

	Death rate per 100,000 population								
Condition	**Population**	**Male**	**Female**	**16-24**	**25-34**	**35-54**	**55+**	**In poverty**	**Not in poverty**
Degeneration	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Alcoholic cardiomyopathy	0.1	0.2	0.0	0.0	0.1	0.0	0.3	0.3	0.1
Alcoholic gastritis	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Alcoholic liver disease	13.0	16.8	9.3	0.0	3.0	17.4	18.2	21.1	11.0
Acute pancreatitis (alcohol induced)	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.3	0.0
Chronic pancreatitis (alcohol induced)	0.1	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.1
Mental and behavioural disorders due to use of alcohol	1.4	1.9	0.9	0.1	0.3	2.1	1.7	2.4	1.1
Accidental poisoning by exposure to alcohol	0.8	1.1	0.6	0.1	0.7	1.4	0.7	1.2	0.8
Tuberculosis	0.5	0.8	0.2	0.0	0.0	0.2	1.2	0.9	0.4
Malignant neoplasm of lip, oral cavity and pharynx	5.0	6.9	3.1	0.3	0.0	1.6	11.6	6.4	4.6
Malignant neoplasm of oesophagus	15.9	22.5	9.6	0.0	0.3	3.7	38.8	16.0	15.9
Malignant neoplasm of colon and rectum	33.6	40.4	27.1	0.0	0.6	5.4	83.9	32.9	33.8
Malignant neoplasm of liver and intrahepatic bile ducts	7.6	9.2	6.2	0.0	0.1	2.0	18.4	7.6	7.6
Malignant neoplasm of larynx	1.3	2.1	0.6	0.0	0.0	0.3	3.3	1.3	1.3
Malignant neoplasm of breast	22.3	0.4	43.3	0.0	1.0	11.9	48.4	19.2	23.1
Diabetes mellitus (type II)	10.6	12.1	9.2	0.1	0.9	2.3	25.6	11.4	10.4
Epilepsy and status epilepticus	2.2	2.6	1.8	1.3	1.7	2.3	2.5	3.1	1.9
Hypertensive diseases	8.6	8.4	8.8	0.0	0.0	1.9	21.0	9.9	8.3
Ischaemic heart disease	149.9	193.4	108.4	0.1	1.5	22.9	376.0	165.4	146.1
Cardiac arrhythmias	6.7	5.0	8.4	0.0	0.0	0.1	17.6	6.5	6.7
haemorrhagic and other non-ischaemic stroke	17.5	16.1	18.7	0.3	1.1	6.2	40.3	16.7	17.6
Ischaemic stroke	54.4	48.9	59.6	0.2	0.5	2.3	141.4	56.5	53.8
Lower respiratory infections: pneumonia	48.2	46.7	49.7	0.5	1.1	5.4	122.1	57.6	45.9
Cirrhosis of the liver	4.3	4.5	4.1	0.0	0.4	2.0	9.4	4.9	4.1
Acute and chronic pancreatitis	2.7	3.1	2.3	0.2	0.4	0.9	6.0	3.0	2.6
Transport injuries (including road traffic accidents)	4.3	6.9	1.7	7.3	4.8	3.7	3.3	4.6	4.2
Fall injuries	8.6	9.6	7.6	0.3	0.7	2.5	20.1	8.9	8.5
Exposure to mechanical forces (including machinery accidents)	0.3	0.5	0.2	0.0	0.3	0.5	0.4	0.3	0.4
Drowning	0.6	0.9	0.3	1.0	0.3	0.5	0.6	0.5	0.6
Other Unintentional Injuries	1.8	2.2	1.4	1.3	0.9	1.4	2.6	2.2	1.7
Accidental poisoning by exposure to noxious substances	5.1	7.7	2.6	3.0	9.9	7.8	1.8	10.1	3.9
Intentional self-harm	9.7	16.2	3.6	6.0	10.2	12.9	8.3	12.4	9.1
Assault	0.1	0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.1
Total	**437**	**488**	**389**	**22**	**41**	**122**	**1,026**	**484**	**426**

4.4.5 Morbidity model parameters

4.4.5.1 Morbidity prevalence rates

Morbidity data for Wales was derived from hospital admission data provided by NWIS for, 2010/11 2011/12 and 2012/13. This data consisted of anonymised, individual admission level data containing all relevant diagnoses associated with the admission as well as the WIMD quintile of the admittee's home address in which they live.

All admissions were categorised according to the primary and up to 13 secondary alcohol-related diagnoses codes for that admission (following a process previously described by the North West Public Health Observatory (NWPHO) who performed similar analyses on English data (33)). Each hospital admission in the dataset was classified as likely to be living below the poverty line (in the most deprived quintile of deprivation) or above the poverty line (in the higher four quintiles of deprivation) under the simplifying assumption that those living in poverty live in the most deprived areas. Costs of hospital admissions and the morbidity multipliers (i.e. the number of hospital admissions per person-specific hospital admission in a year) for the 43 health conditions are based on previous literature (1, 4). Table 4.8 summarises the annual morbidity (i.e. person-specific hospital admission) rates in Wales by gender, age and income groups for each modelled health condition. Table 4.9 presents the headline results of this analysis, with estimated annual morbidity displayed by income groups.

Table 4.8: Hospital admission rates per 100,000 population in Wales by gender, age and income groups for modelled health conditions

	Morbidity rate per 100,000 population								
Condition	**Population**	**Male**	**Female**	**16-24**	**25-34**	**35-54**	**55+**	**In poverty**	**Not in poverty**
Alcohol-induced pseudo-Cushing's syndrome	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Degeneration	0.7	1.1	0.4	0.0	0.1	0.7	1.3	1.3	0.6
Alcoholic polyneuropathy	0.6	1.1	0.2	0.0	0.1	0.7	1.0	0.8	0.6
Alcoholic myopathy	0.1	0.2	0.1	0.0	0.0	0.0	0.3	0.3	0.1
Alcoholic cardiomyopathy	1.6	2.8	0.4	0.0	0.3	1.4	2.9	2.3	1.4
Alcoholic gastritis	2.7	4.2	1.3	2.6	3.1	4.2	1.5	4.6	2.3
Alcoholic liver disease	57.4	77.9	37.8	0.4	10.8	73.9	83.9	90.8	49.1
Acute pancreatitis (alcohol induced)	1.0	1.3	0.7	0.9	0.6	1.6	0.6	1.7	0.8
Chronic pancreatitis (alcohol induced)	7.9	12.6	3.5	1.0	8.2	13.5	5.8	14.7	6.2
Maternal care for (suspected) damage to foetus from	0.1	0.0	0.2	0.2	0.4	0.0	0.0	0.3	0.0
Mental and behavioural disorders due to use of alcohol	248.5	360.7	141.2	160.3	216.7	311.6	241.7	402.2	210.1
Excessive Blood Level of Alcohol	0.4	0.5	0.3	0.4	0.3	0.4	0.5	0.6	0.4
Toxic effect of alcohol	66.0	60.1	71.6	107.7	105.9	87.9	15.2	113.5	54.1
Accidental poisoning by exposure to alcohol	0.3	0.3	0.3	0.6	0.4	0.3	0.1	0.4	0.3
Intentional self-poisoning by and exposure to alcohol	0.4	0.2	0.5	0.4	0.4	0.7	0.1	0.7	0.3
Poisoning by and exposure to alcohol, undetermined	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Evidence of alcohol involvement determined by blood	0.6	0.7	0.4	1.1	0.7	0.3	0.6	0.3	0.7
Tuberculosis	3.8	4.5	3.0	2.7	3.6	2.7	5.2	5.0	3.5
Malignant neoplasm of lip, oral cavity and pharynx	21.1	29.8	12.6	1.2	1.7	12.2	44.0	24.5	20.2
Malignant neoplasm of oesophagus	29.0	41.7	16.8	0.4	0.4	8.2	69.3	27.3	29.4
Malignant neoplasm of colon and rectum	89.6	90.1	89.1	0.3	5.1	30.7	208.2	74.8	93.2
Malignant neoplasm of liver and intrahepatic bile ducts	5.3	4.8	5.7	0.3	0.2	1.6	12.3	4.2	5.5
Malignant neoplasm of larynx	6.4	10.7	2.3	0.1	0.2	1.6	15.4	9.4	5.6
Malignant neoplasm of breast	123.6	0.8	240.9	0.9	11.5	117.3	221.0	95.3	130.6
Diabetes mellitus (typeII)	402.0	480.7	326.8	112.9	122.8	277.1	732.0	473.1	384.3
Epilepsy and status epilepticus	219.5	217.3	221.6	136.6	160.5	173.1	315.0	286.7	202.7
Hypertensive diseases	2,857.7	3,336.1	2,400.3	27.3	123.2	1,169.0	6,488.7	2,994.0	2,823.7
Ischaemic heart disease	478.4	425.8	528.6	2.4	11.8	156.9	1,123.7	528.5	465.8
Cardiac arrhythmias	664.5	491.2	830.2	19.9	37.9	94.5	1,652.1	624.6	674.5
haemorrhagic and other non-ischaemic stroke	21.5	32.1	11.4	2.8	3.7	10.9	44.9	19.5	22.0
Ischaemic stroke	76.4	67.6	84.7	2.7	6.1	25.8	176.2	81.3	75.1
Lower respiratory infections: pneumonia	359.6	289.0	427.1	107.5	164.4	185.3	684.9	422.2	344.0
Cirrhosis of the liver	24.7	22.2	27.1	1.6	2.8	13.7	51.7	28.9	23.6
Acute and chronic pancreatitis	53.7	57.7	49.9	22.0	29.6	38.1	89.0	61.5	51.8
Transport injuries (including road traffic accidents)	88.5	113.7	64.3	165.8	124.5	91.9	40.9	79.8	90.7
Fall injuries	373.5	261.8	480.3	253.0	243.8	194.3	625.5	364.5	375.8
Exposure to mechanical forces (including machinery	146.9	228.7	68.7	283.5	241.2	137.9	64.0	177.1	139.4
Drowning	0.3	0.4	0.3	0.6	0.3	0.2	0.4	0.2	0.4
Other Unintentional Injuries	31.6	42.7	21.0	46.5	49.1	30.7	19.8	31.9	31.6
Accidental poisoning by exposure to noxious substances	28.0	27.7	28.2	57.8	44.6	23.8	13.3	45.1	23.7
Intentional self-harm	75.6	63.3	87.3	195.7	114.1	69.0	18.7	127.0	62.7
Assault	45.9	77.1	16.0	132.1	91.1	34.1	4.2	78.0	37.8
Other Intentional Injuries	0.1	0.2	0.0	0.1	0.4	0.1	0.0	0.1	0.1
Total	**6,615**	**6,942**	**6,303**	**1,852**	**1,942**	**3,398**	**13,076**	**7,299**	**6,445**

Table 4.9: Morbidity model parameters estimated from NWIS admissions data

Condition	Multiplier	Estimated Annual Morbidity			Mean Cost per Morbidity	Total Cost per annum to NHS
		In Poverty (N (%))	Not In Poverty (N (%))	Total (N)		
Alcohol-induced pseudo-Cushing's syndrome	1.17	0 (0%)	1 (100%)	1	£6,827	£6,827
degeneration	1.10	20 (36%)	36 (64%)	56	£19,863	£1,112,306
Alcoholic polyneuropathy	1.14	12 (27%)	33 (73%)	45	£12,378	£557,017
Alcoholic myopathy	1.00	5 (56%)	4 (44%)	9	£15,278	£137,498
Alcoholic cardiomyopathy	1.26	35 (30%)	83 (70%)	118	£10,103	£1,192,212
Alcoholic gastritis	1.09	68 (33%)	137 (67%)	205	£14,651	£3,003,459
Alcoholic liver disease	1.51	1,356 (32%)	2,933 (68%)	4,289	£5,440	£23,332,968
Acute pancreatitis (alcohol induced)	1.27	25 (35%)	47 (65%)	72	£8,508	£612,606
Chronic pancreatitis (alcohol induced)	1.47	220 (37%)	373 (63%)	593	£22,725	£13,475,914
Maternal care for (suspected) damage to foetus from alcohol	1.27	4 (67%)	2 (33%)	6	£8,508	£51,050
Mental and behavioural disorders due to use of alcohol	1.14	6,009 (32%)	12,556 (68%)	18,565	£6,988	£129,729,323
Excessive Blood Level of Alcohol	1.00	9 (29%)	22 (71%)	31	£8,508	£263,761
Toxic effect of alcohol	1.11	1,696 (34%)	3,233 (66%)	4,929	£6,332	£31,209,177
Accidental poisoning by exposure to alcohol	1.03	6 (27%)	16 (73%)	22	£2,121	£46,653
Intentional self-poisoning by and exposure to alcohol	1.27	10 (36%)	18 (64%)	28	£8,508	£238,235
Poisoning by and exposure to alcohol, undetermined intent	1.27	2 (33%)	4 (67%)	6	£8,508	£51,050
Evidence of alcohol involvement determined by blood alcohol level	1.27	4 (09%)	40 (91%)	44	£8,508	£374,370
Tuberculosis	1.27	74 (26%)	208 (74%)	282	£8,508	£2,399,372
Malignant neoplasm of lip, oral cavity and pharynx	1.59	366 (23%)	1,207 (77%)	1,573	£9,825	£15,455,101
Malignant neoplasm of oesophagus	2.19	408 (19%)	1,758 (81%)	2,166	£7,241	£15,684,202
Malignant neoplasm of colon and rectum	2.14	1,117 (17%)	5,573 (83%)	6,690	£10,428	£69,762,541
Malignant neoplasm of liver and intrahepatic bile ducts	1.59	63 (16%)	331 (84%)	394	£7,420	£2,923,625
Malignant neoplasm of larynx	1.47	140 (29%)	337 (71%)	477	£6,981	£3,330,030
Malignant neoplasm of breast	2.35	1,424 (15%)	7,807 (85%)	9,231	£5,284	£48,779,335
Diabetes mellitus (typeII)	1.31	7,069 (24%)	22,965 (76%)	30,034	£6,205	£186,372,892

Condition	Multiplier	Estimated Annual Morbidity			Mean Cost per Morbidity	Total Cost per annum to NHS
		In Poverty (N (%))	Not In Poverty (N (%))	Total (N)		
Epilepsy and status epilepticus	1.16	4,284 (26%)	12,112 (74%)	16,396	£9,219	£151,157,473
Hypertensive diseases	1.19	44,734 (21%)	168,757 (79%)	213,491	£5,897	£1,258,995,537
Ischaemic heart disease	1.19	7,896 (22%)	27,841 (78%)	35,737	£5,376	£192,135,669
Cardiac arrhythmias	1.27	9,332 (19%)	40,309 (81%)	49,641	£8,412	£417,557,651
Haemorrhagic and other non-ischaemic stroke	1.07	291 (18%)	1,315 (82%)	1,606	£6,748	£10,836,830
Ischaemic stroke	1.07	1,215 (21%)	4,489 (79%)	5,704	£8,822	£50,318,434
Lower respiratory infections: pneumonia	1.27	6,308 (23%)	20,557 (77%)	26,865	£8,508	£228,578,453
Cirrhosis of the liver	1.32	432 (23%)	1,411 (77%)	1,843	£5,403	£9,958,092
Acute and chronic pancreatitis	1.10	919 (23%)	3,094 (77%)	4,013	£5,828	£23,388,961
Transport injuries (including road traffic accidents)	1.05	1,192 (18%)	5,418 (82%)	6,610	£17,122	£113,173,998
Fall injuries	1.05	5,446 (20%)	22,458 (80%)	27,904	£5,004	£139,636,951
Exposure to mechanical forces (including machinery accidents)	1.06	2,646 (24%)	8,330 (76%)	10,976	£6,165	£67,667,686
Drowning	1.00	3 (12%)	23 (88%)	26	£3,550	£92,288
Other Unintentional Injuries	1.06	477 (20%)	1,887 (80%)	2,364	£4,286	£10,132,326
Accidental poisoning by exposure to noxious substances	1.03	674 (32%)	1,415 (68%)	2,089	£8,508	£17,774,070
Intentional self-harm	1.15	1,897 (34%)	3,750 (66%)	5,647	£4,965	£28,037,578
Assault	1.04	1,165 (34%)	2,262 (66%)	3,427	£5,368	£18,394,540
Other Intentional Injuries	1.10	1 (14%)	6 (86%)	7	£8,508	£59,559
Total		**109,054 (22%)**	**385,158 (78%)**	**494,212**		**£3,287,997,622**

4.4.5.2 Health related quality of life

Utilities for all 43 conditions included in the model were derived from a single source, the Health Outcomes Data Repository (HODaR) (34), to avoid potential bias and variability between studies. The HODaR data measures utilities using the EQ-5D, a widely used generic (disease non-specific) quality of life instrument as recommended by NICE for health economic evaluation. Full details of the methodology for deriving these utilities has been described elsewhere (1).

4.4.5.3 Valuation of Health Harms and Discounting

In this analysis QALYs and costs were discounted at 3.5% annually. All costs are presented in 2014 prices.

4.5 CONSUMPTION TO CRIME HARMS MODEL

4.5.1 Summary of crime model structure

The model examines the impact of changes in alcohol consumption on rates and associated costs for 18 crime categories listed in

Table 4.10.

A simplified schematic of the crime model is shown in Figure 4.16. As for the health model, the main mechanism is the PIF, which is calculated based on the consumption distribution at time *0* and time *t* and an estimated risk function. The PIF is then applied directly to the baseline number of offences to give a new volume of crime for time *t*. The crime model uses the imputed heavy drinking occasion measure, defined as number of heavy drinking occasions per week, since crime is assumed to be a consequence of acute drinking rather than mean drinking (and so there is no time delay between change in exposure to alcohol and subsequent change in risk of committing a crime).

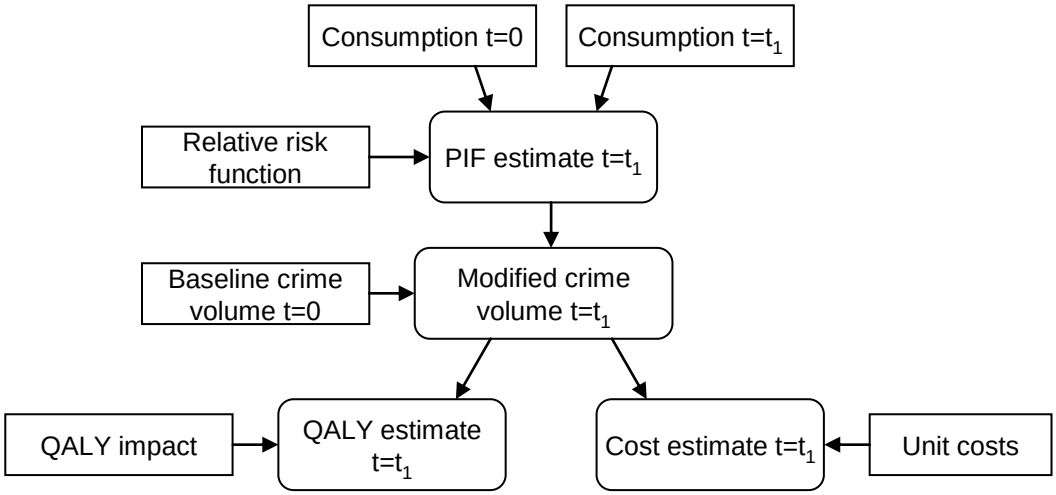


Figure 4.16: Simplified structure of the crime model

Outcomes are presented in terms of the number of offences and the associated cost of crime. The outcomes from the 'do nothing' and the policy scenario are then compared to estimate the incremental effect of the implementation of the policy. In this analysis, loss of QALYs for crime victims is set to zero as the related cost is embedded within the estimated financial costs of crime.

4.5.2 Baseline volumes of crime

Baseline data on the number of recorded offences for England and Wales is published by the ONS. However, this data is not available broken down for Wales or by the age and/or gender of the offender. The data was split between England and Wales according to the proportion of crime in Wales for the year to September 2012 at offence group level provided by the Welsh Government. In order to apportion the volumes of recorded crime between age-gender subgroups in the model, data was obtained from the Department of Justice for each offence giving the age-gender distribution of those convicted in the England and Wales courts in 2011. This distribution is used to estimate the volumes of recorded crime committed within each age-gender subgroup under the assumption that the distribution of offenders is the same as the distribution of those convicted of each offence.

The ONS data only covers recorded crime; however the total number of offences committed is likely to be substantially in excess of this number. The Home Office have previously estimated multipliers which relate the number of recorded offences to the number of actual offences estimated to have been committed for various different crime categories (35). These multipliers are matched to the Welsh crime categories in order to estimate the total baseline volumes of each crime.

Table 4.10 presents the estimated volumes for each crime category in the model together with the estimated costs of each crime (also taken from the Home Office report as no Welsh-specific estimates of the unit cost of crimes could be identified).

Table 4.10: Baseline crime volumes in Wales

Crime category	Recorded Volume (2013)	Multiplier	Estimated Total Volume	Unit Costs
Causing death by dangerous driving under the influence, driving after consuming excess alcohol	2	1.00	2	£2,004,850
More serious wounding	1101	1.50	1,652	£29,086
Less serious wounding	17598	1.50	26,398	£11,060
Assault on a constable	695	7.90	5,488	£1,977
Assault without injury	9822	7.90	77,591	£1,977
Criminal damage	30934	5.90	182,512	£1,190
Theft from the person	2334	4.60	10,737	£862
Robbery	610	4.80	2,927	£9,953
Robbery (Business)	66	4.80	316	£10,588
Burglary in a dwelling	7567	2.80	21,187	£4,434
Burglary not in a dwelling	11664	1.90	22,162	£5,206
Theft of a pedal cycle	3223	3.60	11,604	£862
Theft from vehicle	12550	3.50	43,927	£1,168
Aggravated vehicle taking	235	1.30	305	£5,615
Theft of vehicle	3138	1.30	4,080	£5,615
Other theft	17909	2.70	48,355	£862
Theft from shops	16792	16.10	270,345	£140
Violent disorder	36	1.50	54	£14,270
Total sexual offence	3172	13.60	43,145	£41,745
Homicide	29	1.00	29	£2,004,850

4.5.3 Crime risk function parameters

Prevalence-based risk modelling is not as well developed for crime as for chronic health conditions. Risk functions for crime harms are not generally available in the literature and need to be estimated using AAFs. AAFs have previously been estimated for the UK from the Offending Crime and Justice Survey using a methodology described elsewhere (1). These AAFs are matched to the Welsh crime categories and risk functions fitted for each age-gender subgroup using the imputed heavy drinking occasion measure as described in Section 4.2.3.

The AAF evidence can be used to derive a relative risk function assuming the relationship described in Equation 2 since the AAF is a positive function of the prevalence of drinking and the relative risk function. Two assumptions are necessary to compute a relative function from an AAF: assumptions about the form of the curve (or risk function) and assumptions about the threshold below which the

relative risk is unity (i.e. harm is not associated with alcohol). Linear functions were selected for the present analyses due to the lack of data in the literature; and the thresholds are set at 4/3 units for men/women as in previous models.

The resulting relative risk functions are therefore a function of consumption, defined as the peak day consumption (for which a slope is defined) and threshold as follows:

$RR\ c\ = 1\ if\ c < T$

$RR\ c\ = \beta\ \ c - T\ \ + 1\ \ otherwise$ *Equation 6*

where *c* = mean number of heavy drinking occasions per week, *T* = 4/3 for men/women and *β*=slope parameter. The slope of the fitted crime risk functions are shown in Table 4.11.

Table 4.11: Crime risk functions – slope of the linear functions used for crime

Offence	**AAF used**	**Male**	**Female**
		16 years and over	**16 years and over**
More serious wounding	Assault with Injury	0.03203544	0.13645825
Less serious wounding	Assault with Injury	0.03203544	0.13645825
Assault on a constable	Assault without Injury	0.05519942	0.05958004
Assault without injury	Assault without Injury	0.05519942	0.05958004
Criminal damage	Criminal damage	0.11350553	0.17889635
Theft from the person	Other theft	0.00357048	0.00455364
Robbery	Other theft	0.00357048	0.00455364
Robbery (Business)	Other theft	0.00357048	0.00455364
Burglary in a dwelling	Other theft	0.00357048	0.00455364
Burglary not in a dwelling	Other theft	0.00357048	0.00455364
Theft of a pedal cycle	Other theft	0.00357048	0.00455364
Theft from vehicle	Vehicle related thefts	0.01407349	0.36564477
Aggravated vehicle taking	Vehicle related thefts	0.01407349	0.36564477
Theft of vehicle	Vehicle related thefts	0.01407349	0.36564477
Other theft	Other theft	0.00357048	0.00455364
Theft from shops	Other theft	0.00357048	0.00455364
Violent disorder	All violent offences	0.04264595	0.09301268
Total sexual offence	All violent offences	0.04264595	0.09301268
Homicide	All violent offences	0.04264595	0.09301268

4.6 CONSUMPTION TO WORKPLACE HARMS MODEL

4.6.1 Summary of workplace model structure

A simplified schematic of the workplace model is shown in Figure 4.17. Based on baseline consumption, consumption at time t and risk functions derived above, a PIF is calculated and applied to the absence rate. Absenteeism is assumed to be related to imputed heavy drinking occasion measure, defined as number of heavy drinking occasions per week, and it is assumed that there is no time delay between change in exposure to alcohol and subsequent change in risk of absenteeism.

4.6.2 Baseline absence data

Using the quarterly Labour Force Survey (36), a UK-wide survey of individuals' employment circumstances, retaining only those respondents from Wales and pooling data from several survey waves (2013 quarters 2-4 and 2014 quarter 1) in order to generate a suitably large sample size (N=15,134), the number of days absent from work is calculated based on the absence rate, the mean number of days worked and the number of working individuals in each age/gender subgroup. Days absent from work are then valued using individuals' daily gross income.

Table 4.12: Work absence inputs – baseline levels of employment and sickness absence in 2013/14 in Wales from the Labour Force Survey.

Gender	Age	Individuals in work	Individuals unemployed or inactive	Average number of days worked per week	Overall rate of absence from work	Total absence days
Male	**16-24**	95,017	97,083	4.3	1.00%	212,361
	25-34	154,159	28,341	4.9	1.15%	448,885
	35-54	342,628	55,172	4.9	0.75%	659,305
	55+	145,063	299,737	4.8	2.00%	720,820
Female	**16-25**	90,332	92,168	3.9	0.69%	126,183
	25-35	129,851	51,249	4.3	1.85%	536,342
	35-55	324,981	86,819	4.4	2.28%	1,686,401
	55+	117,460	380,140	4.2	2.29%	586,630
Population		1,399,491	1,090,709	4.6	1.50%	4,976,928

Outcomes for two scenarios – do nothing and policy implementation – are computed separately. The difference is then taken to estimate the incremental effect of the policy.

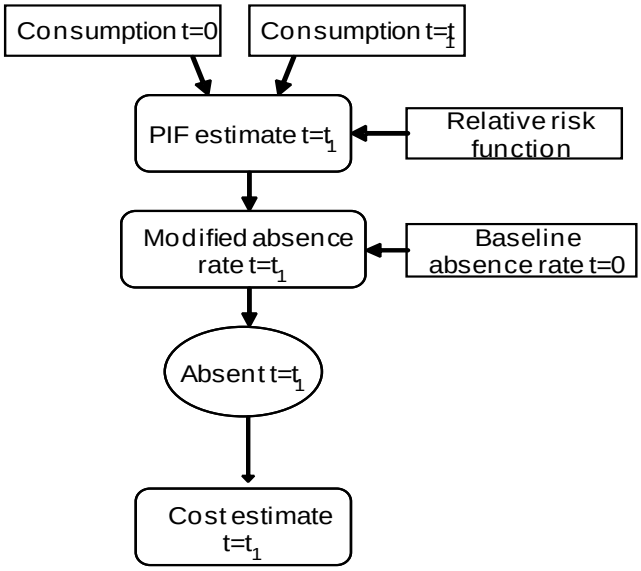


Figure 4.17: Simplified structure of the workplace model

4.6.3 Workplace risk function parameters

AAFs for alcohol-related workplace absenteeism were based on previous literature (37). Relative risk functions were calculated for each age-gender group derived from the AAFs applying the same method for calculating crime risk functions (see Section 4.5.3). Absenteeism due to alcohol was assumed to be a consequence of acute consumption, measured by the peak day consumption in the model. The slope of the fitted absenteeism risk functions are presented in Table 4.13.

Table 4.13: Absenteeism risk functions – slope of the linear functions used for work absence

Age (years)	Absenteeism	
	Male	Female
16 – 24	0.040197977	0.040850376
25 - 34	0.042618688	0.027154106
35- 54	0.020525516	0.015567755
55+	0.011652789	0.000808738

4.7 SENSITIVITY ANALYSES

Best practice for policy modelling suggests reporting a single base case estimate, supported by a range of sensitivity analyses in order to explore the impact of key uncertainties in the evidence base (38). We have focused this approach on the uncertainty around the price elasticities described in Section 4.2.6, as they are the key active ingredient in the appraisal of pricing policies. A range of alternative estimates around the base case elasticities shown in Table 4.3 are examined:

1) All cross-price elasticities in the base case elasticity matrix are assumed to be zero (i.e. there is no cross-price effect between beverages) (SA1);
2) All non-significant elasticities (p-value greater than 0.05) in the base case elasticity matrix are assumed to be zero (SA2);
3) Separate moderate- and increasing/high risk-specific elasticity matrices (SA3);

Further details on these alternative elasticities can be found in Meng et al. (5).

5 RESULTS

This section contains model results for 10 different pricing policies:

- a general 10% price increase on all alcohol products in both the on- and off-trade,
- MUP policies at 35p, 40p, 45p, 50p, 55p, 60p, 65p and 70p, and
- a ban on below-cost selling.

5.1 SUMMARY RESULTS FOR ALL POLICIES

5.1.1 Impact on alcohol consumption

The impacts on consumption across all modelled policies are shown for the total population and population subgroups in Table 5.1. Table 5.2 illustrates the estimated % change and absolute effects of pricing policies on alcohol consumption by income group. Figure 5.1 and Figure 5.2 show relative and absolute changes in consumption across all individual policies by drinker type, whilst Figure 5.3 and Figure 5.4 illustrate the income-specific impacts of different MUP thresholds.

Table 5.1: Summary of estimated effects of pricing policies on alcohol consumption – % and absolute change in consumption per drinker

	Population	Male	Female	Moderate	Increasing risk	High risk	In Poverty	Not in poverty
Population ('000)	2490	1193	1297	1955	392	143	591	1899
Abstainers (%)	16.0%	12.4%	19.3%	20.4%	0.0%	0.0%	25.6%	13.0%
Drinker population ('000)	2092	1045	1048	1557	392	143	440	1653
Baseline units per week (person)	12.3	16.9	8.0	4.3	27.8	78.1	9.3	13.2
Baseline units per week (drinker)	14.6	19.3	9.9	5.5	27.8	78.1	12.5	15.2
Change in consumption per drinker (%)								
10% general price increase	-5.2%	-6.4%	-2.8%	-5.0%	-4.7%	-5.8%	-4.9%	-5.2%
Ban on below-cost selling	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.1%	0.0%
35p MUP	-0.7%	-0.8%	-0.5%	-0.4%	-0.3%	-1.3%	-1.7%	-0.5%
40p MUP	-1.5%	-1.7%	-1.0%	-0.9%	-0.7%	-2.7%	-3.2%	-1.1%
45p MUP	-2.6%	-3.0%	-1.8%	-1.5%	-1.3%	-4.8%	-5.5%	-2.0%
50p MUP	-4.0%	-4.5%	-2.8%	-2.2%	-2.0%	-7.2%	-8.1%	-3.0%
55p MUP	-5.6%	-6.3%	-4.2%	-3.2%	-3.0%	-10.0%	-11.2%	-4.4%
60p MUP	-7.6%	-8.5%	-5.9%	-4.5%	-4.4%	-13.2%	-14.5%	-6.1%
65p MUP	-9.9%	-11.0%	-7.8%	-6.1%	-6.1%	-16.5%	-17.8%	-8.2%
70p MUP	-12.3%	-13.5%	-10.0%	-7.9%	-7.9%	-20.0%	-21.1%	-10.4%
Change in consumption per drinker (units per year)								
10% general price increase	-39.4	-64.4	-14.5	-14.3	-67.8	-234.7	-32.0	-41.4
Ban on below-cost selling	-0.2	-0.3	-0.2	0.0	-0.3	-2.4	-0.7	-0.1
35p MUP	-5.3	-8.0	-2.5	-1.2	-4.2	-52.1	-10.9	-3.8
40p MUP	-11.3	-17.3	-5.2	-2.5	-10.2	-109.9	-21.0	-8.7
45p MUP	-19.8	-30.3	-9.2	-4.2	-18.3	-193.8	-35.7	-15.5
50p MUP	-30.2	-45.7	-14.7	-6.4	-28.8	-293.2	-53.0	-24.1
55p MUP	-42.8	-63.9	-21.7	-9.1	-43.9	-407.1	-72.8	-34.8
60p MUP	-58.2	-86.0	-30.6	-12.9	-63.8	-537.1	-94.6	-48.6
65p MUP	-75.5	-110.7	-40.3	-17.4	-88.0	-673.6	-116.2	-64.6
70p MUP	-93.9	-136.5	-51.4	-22.4	-114.8	-814.6	-137.7	-82.2

Table 5.2: Summary of estimated effects of pricing policies on alcohol consumption by drinker group and income

	In Poverty			Not in poverty		
	Moderate	Increasing risk	High risk	Moderate	Increasing risk	High risk
Population ('000)	496	65	29	1458	327	113
Abstainers (%)	30.4%	0.0%	0.0%	16.9%	0.0%	0.0%
Drinker population ('000)	345	65	29	1212	327	113
Baseline units per week (person)	3.4	25.9	71.7	4.7	28.2	79.8
Baseline units per week (drinker)	4.9	25.9	71.7	5.6	28.2	79.8
Change in consumption per drinker (%)						
10% general price increase	-5.0%	-4.9%	-4.9%	-5.1%	-4.6%	-6.0%
Ban on below-cost selling	-0.1%	-0.1%	-0.2%	0.0%	0.0%	0.0%
35p MUP	-0.7%	-1.4%	-2.7%	-0.4%	-0.1%	-0.9%
40p MUP	-1.3%	-2.7%	-5.2%	-0.8%	-0.3%	-2.1%
45p MUP	-2.4%	-4.4%	-8.8%	-1.2%	-0.7%	-3.8%
50p MUP	-3.9%	-6.2%	-13.0%	-1.8%	-1.2%	-5.8%
55p MUP	-5.6%	-8.6%	-17.8%	-2.6%	-2.0%	-8.2%
60p MUP	-7.7%	-11.3%	-22.5%	-3.7%	-3.1%	-11.0%
65p MUP	-10.1%	-14.5%	-26.8%	-5.1%	-4.5%	-14.2%
70p MUP	-12.6%	-17.6%	-30.8%	-6.7%	-6.1%	-17.5%
Change in consumption per drinker (units per year)						
10% general price increase	-12.9	-66.1	-181.8	-14.8	-68.2	-248.4
Ban on below-cost selling	-0.2	-1.0	-6.4	0.0	-0.2	-1.3
35p MUP	-1.7	-18.7	-101.3	-1.1	-1.3	-39.3
40p MUP	-3.5	-35.8	-195.0	-2.2	-5.1	-87.9
45p MUP	-6.2	-59.3	-330.2	-3.6	-10.1	-158.5
50p MUP	-10.1	-84.3	-487.3	-5.3	-17.7	-243.0
55p MUP	-14.5	-115.6	-663.5	-7.6	-29.7	-340.7
60p MUP	-19.9	-153.1	-842.6	-10.9	-46.1	-458.1
65p MUP	-26.0	-196.1	-1000.4	-15.0	-66.5	-589.0
70p MUP	-32.6	-238.2	-1150.1	-19.5	-90.3	-727.7

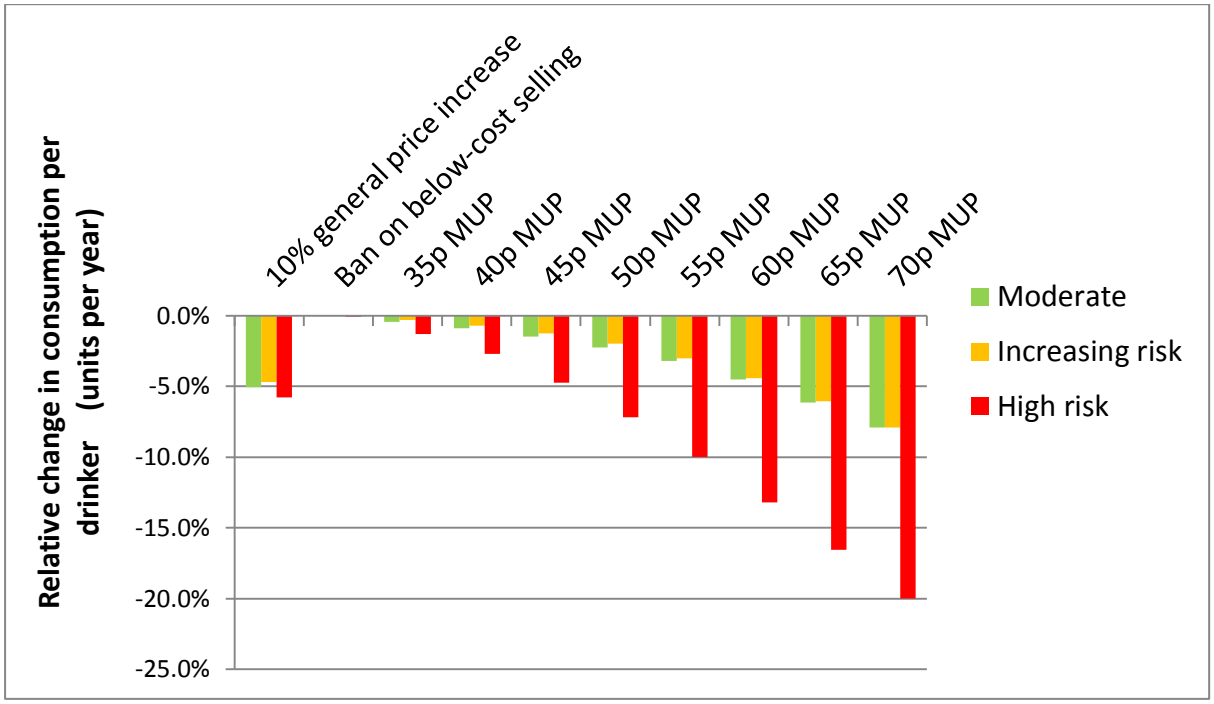


Figure 5.1: Summary of relative consumption changes by policy by drinker group

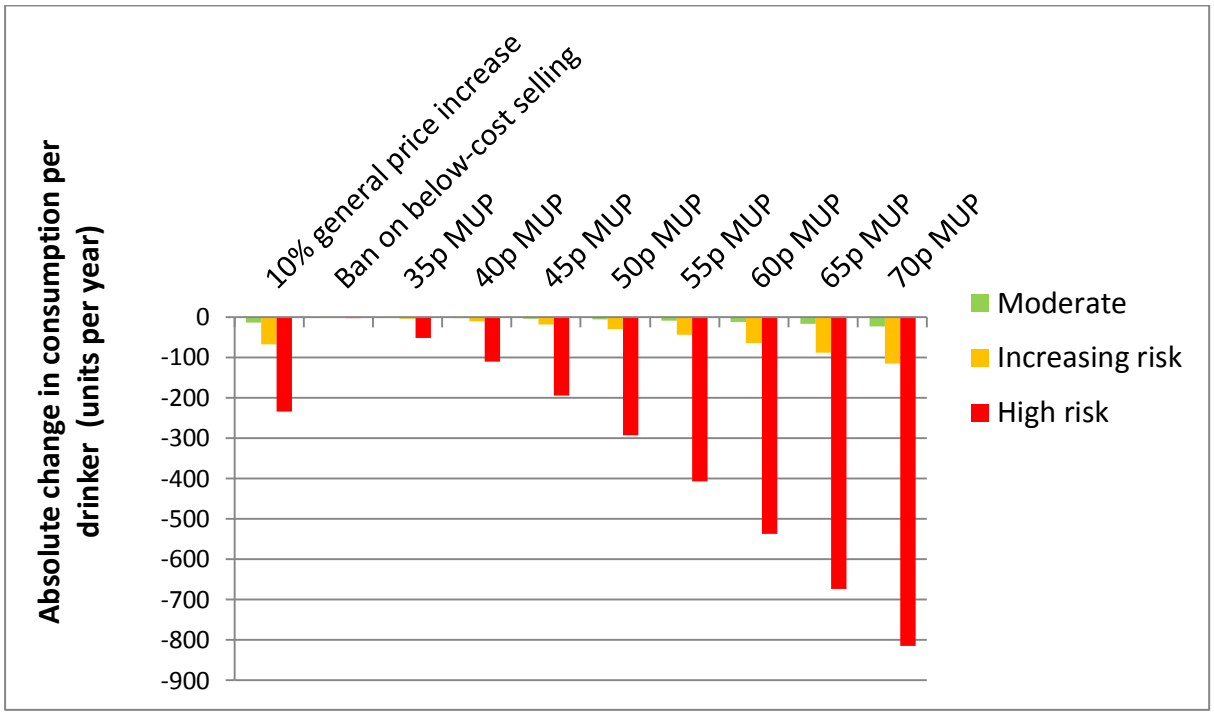


Figure 5.2: Summary of absolute consumption changes by policy by drinker group

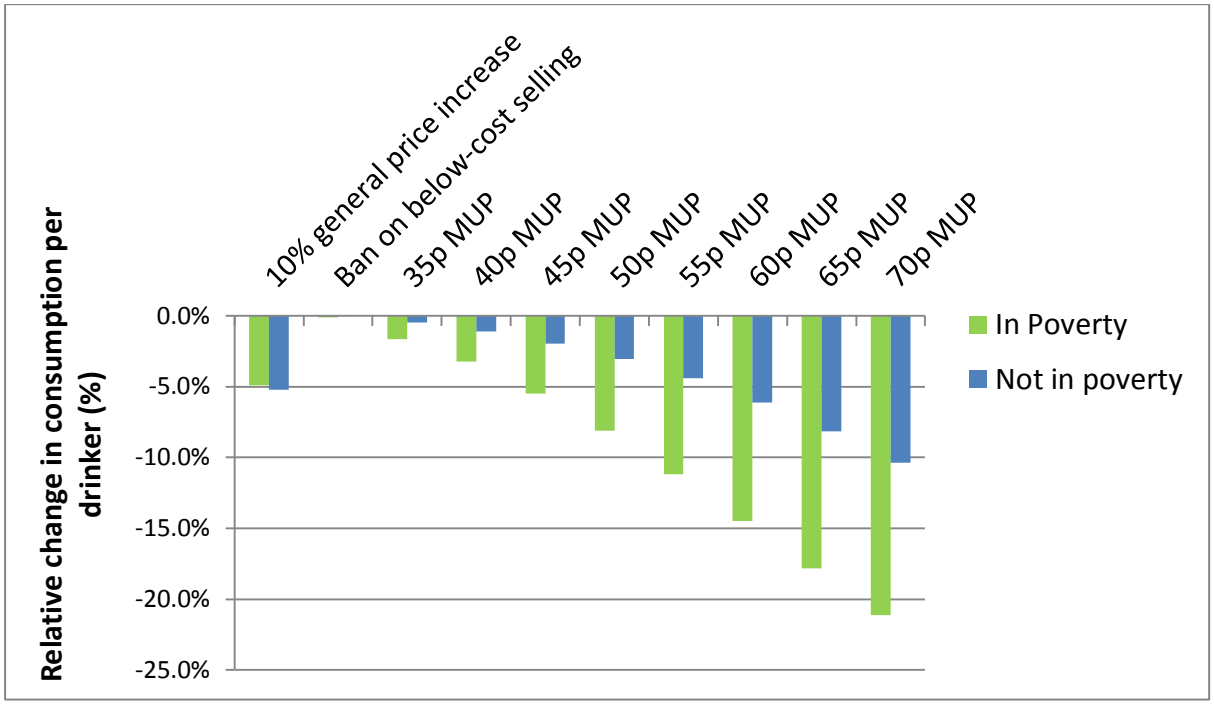


Figure 5.3: Summary of relative consumption changes by policy by income group

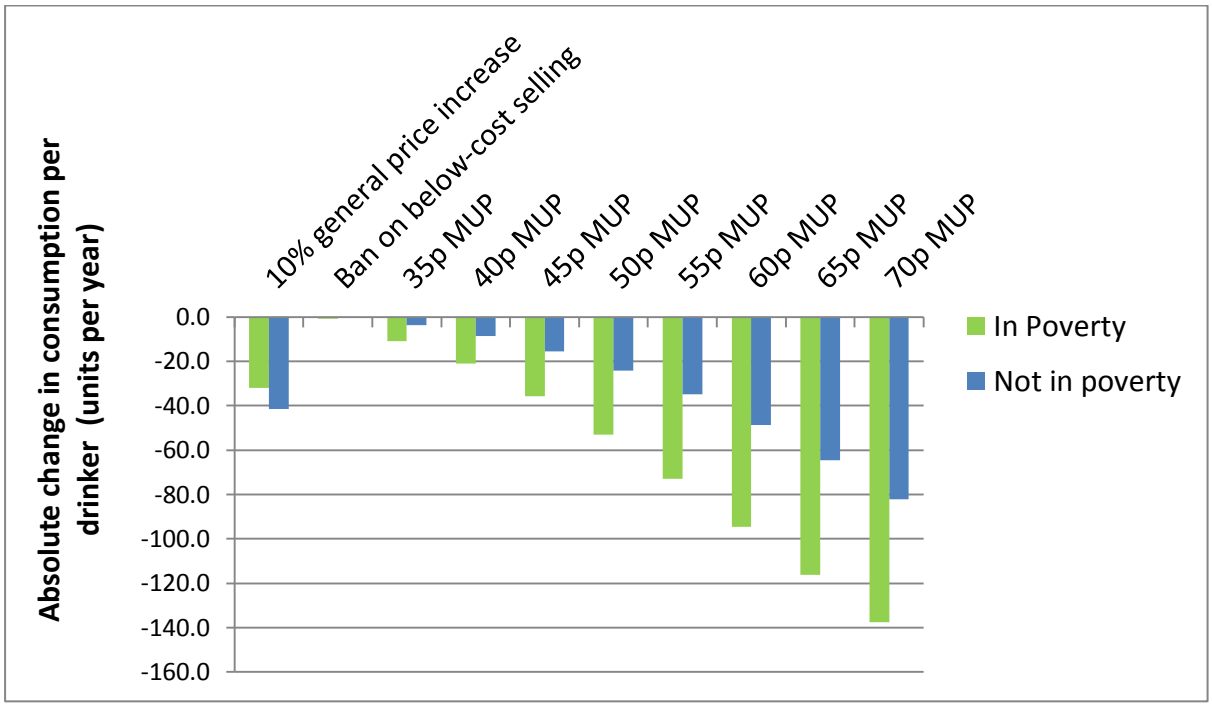


Figure 5.4: Summary of absolute consumption changes by policy by income group

5.1.2 Impact on consumer spending

Table 5.3 (and Figure 5.5 and Figure 5.6) shows the relative and absolute changes in consumer spending estimated to result from each of the modelled policies. Table 5.4 (and Figure 5.7 and Figure 5.8) illustrates the estimated impact on spending for different drinker groups by income group.

Table 5.3: Summary of estimated effects of pricing policies on consumer spending – absolute and % change in consumption per drinker per year

	Population	Male	Female	Moderate	Increasing risk	High risk	In Poverty	Not in poverty
Drinker population ('000)	2092	1045	1048	1557	392	143	440	1653
Baseline annual spending (£ per drinker)	651.74	905.44	398.73	305.05	1187.68	2957.79	394.66	720.10
Change in spending per drinker (%)								
10% general price increase	4.7%	3.1%	8.4%	5.4%	5.2%	3.4%	3.6%	4.9%
Ban on below-cost selling	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
35p MUP	0.1%	0.0%	0.5%	0.0%	0.3%	0.1%	0.2%	0.1%
40p MUP	0.3%	0.0%	0.9%	0.0%	0.6%	0.3%	0.4%	0.3%
45p MUP	0.8%	0.2%	2.0%	0.3%	1.4%	0.6%	0.7%	0.8%
50p MUP	1.6%	0.6%	3.7%	0.8%	2.8%	1.1%	1.2%	1.6%
55p MUP	2.5%	1.1%	5.6%	1.4%	4.4%	1.6%	1.5%	2.6%
60p MUP	3.4%	1.4%	7.9%	2.0%	6.3%	1.8%	1.4%	3.7%
65p MUP	4.2%	1.5%	10.3%	2.6%	8.1%	1.8%	1.3%	4.7%
70p MUP	4.9%	1.5%	12.6%	3.2%	9.9%	1.3%	0.8%	5.5%
Change in spending per drinker (£ per year)								
10% general price increase	30.64	27.90	33.37	16.52	61.67	99.28	14.19	35.02
Ban on below-cost selling	0.09	0.01	0.17	0.02	0.15	0.67	0.14	0.07
35p MUP	0.93	0.02	1.83	-0.09	3.72	4.35	0.91	0.93
40p MUP	1.99	0.29	3.69	0.09	7.24	8.26	1.42	2.14
45p MUP	4.99	1.94	8.04	0.88	16.99	16.88	2.78	5.58
50p MUP	10.14	5.69	14.58	2.37	32.88	32.35	4.88	11.54
55p MUP	16.22	10.07	22.35	4.27	52.65	46.38	5.75	19.00
60p MUP	22.24	12.96	31.49	6.15	74.61	53.68	5.65	26.65
65p MUP	27.65	14.03	41.24	8.00	96.75	52.08	5.05	33.67
70p MUP	31.99	13.57	50.36	9.64	117.83	39.77	3.32	39.62

Table 5.4: Summary of estimated effects of pricing policies on consumer spending by drinker group and income

	In Poverty			Not in poverty		
	Moderate	Increasing risk	High risk	Moderate	Increasing risk	High risk
Drinker population ('000)	345	65	29	1212	327	113
Baseline annual spending (£ per drinker)	194.92	910.44	1601.70	336.42	1242.66	3308.77
Change in spending per drinker (%)						
10% general price increase	4.7%	3.7%	1.9%	5.5%	5.4%	3.5%
Ban on below-cost selling	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
35p MUP	0.2%	0.1%	0.5%	-0.1%	0.3%	0.1%
40p MUP	0.4%	0.2%	0.5%	0.0%	0.7%	0.2%
45p MUP	0.7%	0.8%	0.6%	0.2%	1.5%	0.6%
50p MUP	1.1%	1.9%	0.5%	0.7%	2.9%	1.2%
55p MUP	1.4%	3.0%	-0.4%	1.4%	4.6%	1.8%
60p MUP	1.7%	3.8%	-2.0%	2.1%	6.6%	2.3%
65p MUP	2.0%	4.1%	-3.3%	2.7%	8.7%	2.4%
70p MUP	1.9%	4.3%	-5.0%	3.4%	10.7%	2.1%
Change in spending per drinker (£ per year)						
10% general price increase	9.1	33.9	30.6	18.6	67.2	117.1
Ban on below-cost selling	0.0	0.1	1.5	0.0	0.2	0.5
35p MUP	0.4	1.0	7.2	-0.2	4.3	3.6
40p MUP	0.8	1.8	8.3	-0.1	8.3	8.2
45p MUP	1.4	7.0	10.1	0.7	19.0	18.6
50p MUP	2.15	17.74	8.50	2.44	35.88	38.52
55p MUP	2.8	27.4	-7.1	4.7	57.7	60.2
60p MUP	3.4	34.3	-31.4	6.9	82.6	75.7
65p MUP	3.8	37.4	-52.4	9.2	108.5	79.1
70p MUP	3.7	38.9	-80.1	11.3	133.5	70.8

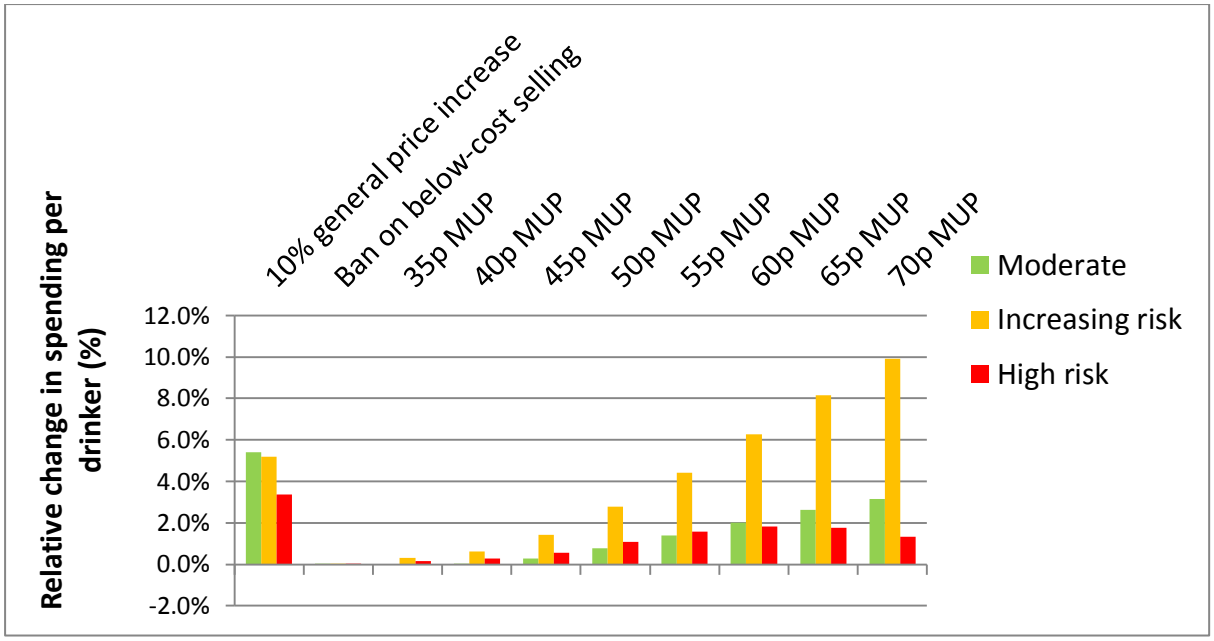


Figure 5.5: Summary of relative spending changes by policy by drinker group

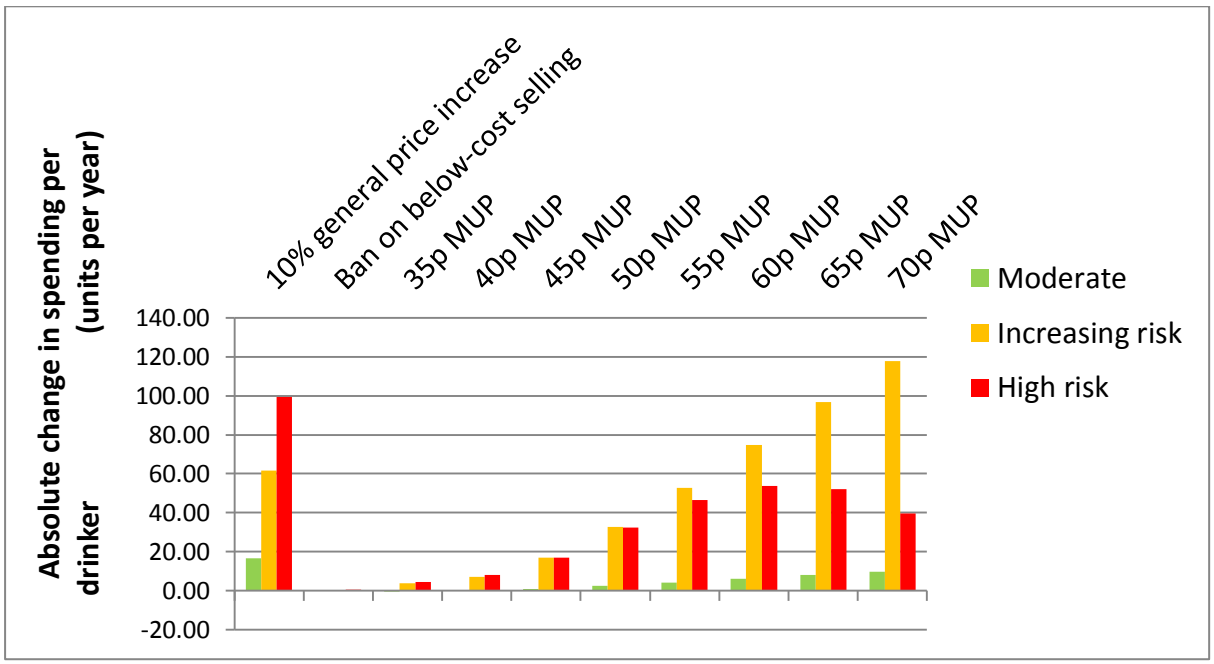


Figure 5.6: Summary of absolute spending changes by policy by drinker group

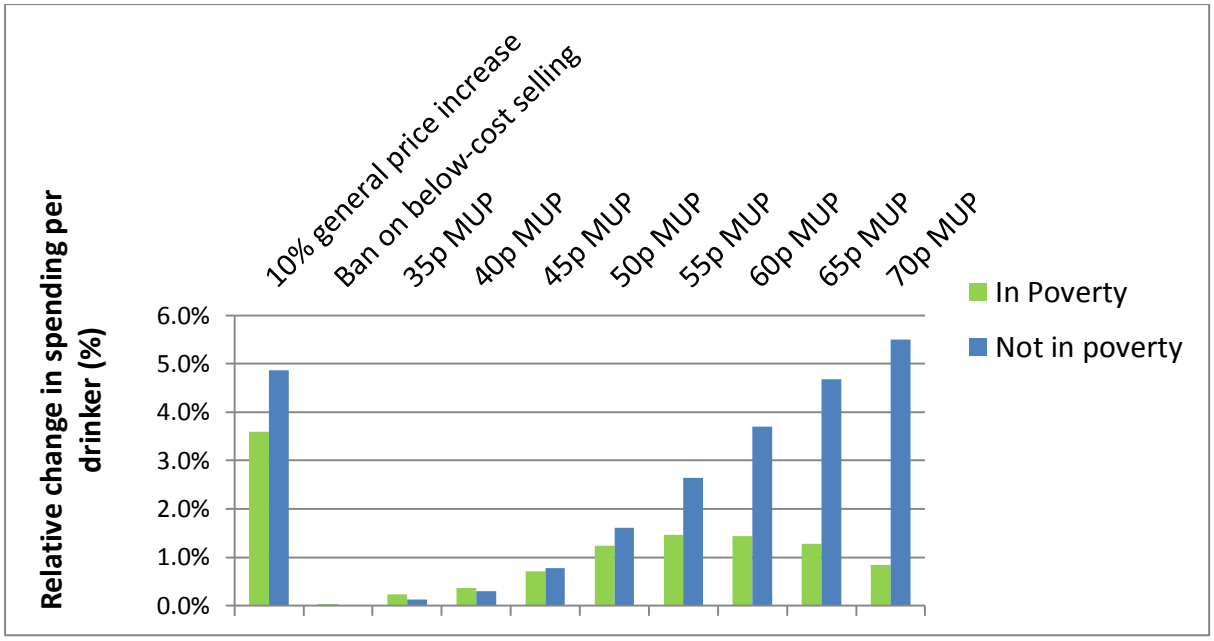


Figure 5.7: Summary of relative spending changes by policy by income group

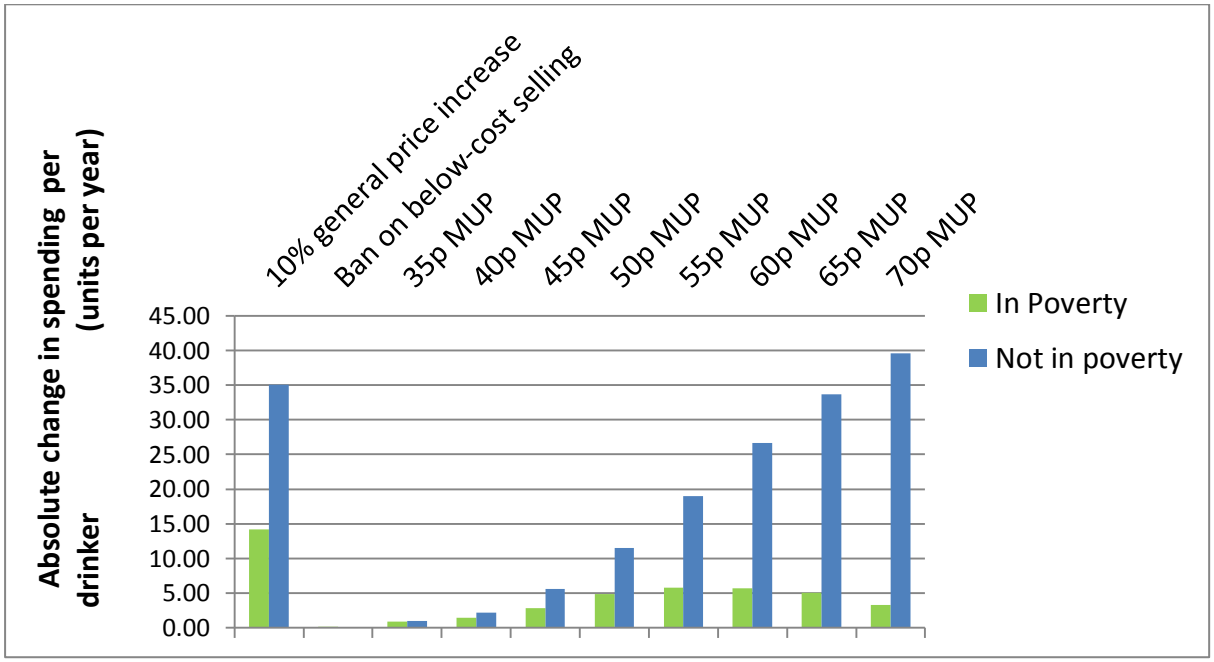


Figure 5.8: Summary of absolute spending changes by policy by income group

5.1.3 Impact on retailers and the Exchequer

Table 5.5 shows the estimated impact of each policy on duty and VAT revenues to the Exchequer as well as the total revenue to retailers, separated between the on- and off-trades.

Table 5.5: Summary of estimated effects of pricing policies on retailer and duty/VAT revenue – % and absolute

	Change in duty+VAT to government			Change in revenue to retailers (excluding duty+VAT)		
	Off-trade	**On-trade**	**Total**	**Off-trade**	**On-trade**	**Total**
Baseline receipts (£ million)	284.9	268.2	553.0	203.9	606.6	810.6
Relative change (%)						
10% general price increase	-1.0%	-0.5%	-0.8%	15.2%	6.2%	8.4%
Ban on below-cost selling	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
35p MUP	-0.2%	-0.2%	-0.2%	1.8%	-0.1%	0.4%
40p MUP	-0.6%	-0.2%	-0.4%	3.5%	-0.1%	0.8%
45p MUP	-1.3%	-0.2%	-0.7%	7.0%	0.1%	1.8%
50p MUP	-2.0%	0.0%	-1.0%	12.2%	0.3%	3.3%
55p MUP	-3.0%	0.2%	-1.4%	18.5%	0.7%	5.2%
60p MUP	-4.2%	0.2%	-2.1%	25.7%	0.9%	7.1%
65p MUP	-5.7%	0.2%	-2.9%	33.0%	1.1%	9.1%
70p MUP	-7.6%	0.1%	-3.8%	39.6%	1.2%	10.9%
Absolute change (£ million)						
10% general price increase	-3.0	-1.3	-4.3	31.0	37.4	68.4
Ban on below-cost selling	-0.1	0.0	-0.1	0.2	0.0	0.3
35p MUP	-0.5	-0.5	-1.0	3.6	-0.7	2.9
40p MUP	-1.8	-0.6	-2.4	7.1	-0.5	6.6
45p MUP	-3.7	-0.5	-4.1	14.2	0.4	14.6
50p MUP	-5.7	0.0	-5.8	25.0	2.0	27.0
55p MUP	-8.5	0.5	-7.9	37.7	4.2	41.9
60p MUP	-12.0	0.6	-11.4	52.4	5.4	57.9
65p MUP	-16.3	0.5	-15.8	67.3	6.4	73.7
70p MUP	-21.6	0.3	-21.2	80.7	7.4	88.1

5.1.4 Impact on health outcomes

Table 5.6 presents the impact of each modelled policy on deaths and hospital admissions per year at full effect (i.e. in the 20th year following policy implementation) as well as the estimated annual QALY gains. These are shown as relative changes in deaths and hospital admissions in Figure 5.9. Table 5.7 illustrates the equity implications of the health impact of each policy by showing the reductions in deaths and hospitalisations per 100,000 population for each income group. These figures are illustrated graphically in Figure 5.10 and Figure 5.11 for deaths and hospital admissions respectively.

Table 5.10 presents the changing impact from 1 to 20 years following policy implementation, as various health conditions with different lag times to effect come into play at different times.

Table 5.6: Summary of policy impacts on health outcomes – changes in alcohol-related deaths, hospital admissions and QALYs per year at full effect (in 20th year)

	Deaths reduction in 20th year					Hospital admission reductions in 20th year					
	100% attributable	Partial attributable chronic[1]	Partial attributable injury	Ischaemic heart disease, ischaemic stroke and typeII diabetes[2]	**Total**	100% attributable	Partial attributable chronic	Partial attributable injury	Ischaemic heart disease, ischaemic stroke and typeII diabetes	**Total**	**QALYs gained in 20th year (discounted)**
Alcohol-attributable harm (burden of disease)[3]	404	743	194	-556	785	15378	21895	5151	-5074	37350	6381
Relative change (%)											
10% general price increase	-8.1%	-5.3%	-6.5%	1.5%	-11.9%	-6.8%	-6.3%	-5.4%	-0.3%	-7.2%	11.3%
Ban on below-cost selling	-0.1%	0.0%	0.0%	0.0%	-0.1%	-0.1%	-0.1%	0.0%	0.0%	-0.1%	0.1%
35p MUP	-0.8%	-0.5%	-0.8%	-0.3%	-0.8%	-0.7%	-0.3%	-0.6%	-0.2%	-0.5%	1.0%
40p MUP	-2.0%	-1.1%	-1.7%	-0.4%	-2.2%	-1.6%	-0.8%	-1.3%	-0.2%	-1.3%	2.5%
45p MUP	-3.8%	-1.9%	-2.9%	-0.3%	-4.3%	-2.9%	-1.5%	-2.4%	-0.3%	-2.4%	4.6%
50p MUP	-5.9%	-3.0%	-4.4%	-0.2%	-6.8%	-4.6%	-2.5%	-3.8%	-0.5%	-3.8%	7.2%
55p MUP	-8.5%	-4.4%	-6.3%	0.0%	-10.1%	-6.6%	-3.8%	-5.6%	-0.6%	-5.6%	10.4%
60p MUP	-11.7%	-6.1%	-8.6%	0.5%	-14.3%	-9.1%	-5.6%	-7.8%	-0.7%	-8.0%	14.5%
65p MUP	-15.2%	-8.1%	-11.2%	1.1%	-19.0%	-11.9%	-7.7%	-10.3%	-0.7%	-10.7%	19.1%
70p MUP	-18.8%	-10.3%	-13.8%	1.9%	-24.1%	-14.9%	-10.1%	-12.9%	-0.8%	-13.7%	24.0%
Absolute change											
10% general price increase	-33	-40	-13	-8	-93	-1044	-1374	-278	15	-2681	718
Ban on below-cost selling	0	0	0	0	-1	-9	-12	-2	0	-23	6
35p MUP	-3	-4	-1	2	-7	-114	-61	-29	8	-196	66
40p MUP	-8	-8	-3	2	-18	-252	-175	-68	12	-483	157
45p MUP	-15	-14	-6	2	-34	-452	-333	-123	18	-891	292
50p MUP	-24	-23	-9	1	-53	-704	-545	-196	23	-1422	458
55p MUP	-34	-33	-12	0	-79	-1010	-825	-287	28	-2094	666
60p MUP	-47	-45	-17	-3	-112	-1396	-1219	-401	33	-2983	928
65p MUP	-61	-60	-22	-6	-149	-1828	-1686	-529	36	-4007	1221
70p MUP	-76	-76	-27	-10	-190	-2285	-2211	-663	41	-5117	1532

[1] Excludes ischaemic heart disease, ischaemic stroke and type II diabetes; [2] Alcohol are estimated to have an overall protective effect for ischaemic heart disease, ischaemic stroke and type II diabetes; [3] Estimated by modelling a "counterfactual" scenario in which the entire population becomes abstainers, i.e. zero consumption.

Table 5.7: Income-specific health outcomes – policy impacts on deaths and hospital admissions per year per 100,000 population at full effect (in 20th year)

	In poverty		Not in poverty	
Policy	Deaths per 100,000 drinker	Hospital admission per 100,000 drinker	Deaths per 100,000 drinker	Hospital admission per 100,000 drinker
Alcohol-attributable harm (burden of disease)[1]	48.7	1878.4	34.6	1760.4
Relative change (%)				
10% general price increase	-9.9%	-7.0%	-12.6%	-7.2%
Ban on below-cost selling	-0.2%	-0.1%	-0.1%	0.0%
35p MUP	-0.9%	-0.6%	-0.8%	-0.5%
40p MUP	-3.0%	-2.0%	-1.9%	-1.1%
45p MUP	-6.2%	-4.0%	-3.6%	-1.9%
50p MUP	-9.9%	-6.6%	-5.6%	-3.0%
55p MUP	-14.5%	-9.8%	-8.4%	-4.4%
60p MUP	-19.9%	-13.5%	-12.1%	-6.4%
65p MUP	-25.4%	-17.6%	-16.6%	-8.8%
70p MUP	-30.7%	-21.6%	-21.7%	-11.5%
Absolute change				
10% general price increase	-4.8	-131.6	-4.4	-127.2
Ban on below-cost selling	-0.1	-2.6	0.0	-0.7
35p MUP	-0.4	-12.1	-0.3	-8.6
40p MUP	-1.5	-36.9	-0.7	-19.4
45p MUP	-3.0	-74.8	-1.2	-34.0
50p MUP	-4.8	-124.2	-1.9	-53.0
55p MUP	-7.1	-183.3	-2.9	-77.9
60p MUP	-9.7	-254.4	-4.2	-112.8
65p MUP	-12.4	-330.6	-5.7	-154.5
70p MUP	-15.0	-405.4	-7.5	-201.8

[1] Estimated by modelling a "counterfactual" scenario in which the entire population becomes abstainers, i.e. zero consumption.

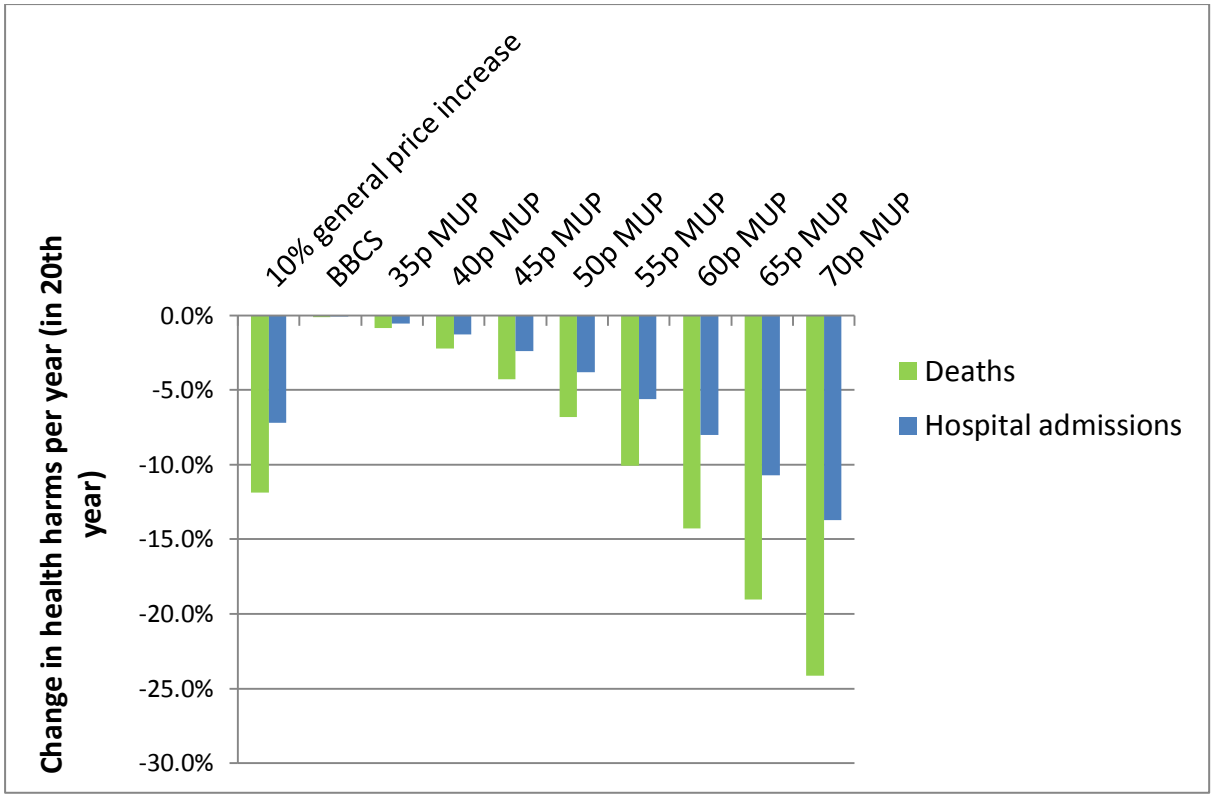


Figure 5.9: Summary of relative changes in deaths and hospital admissions per year at full effect (in 20th year)

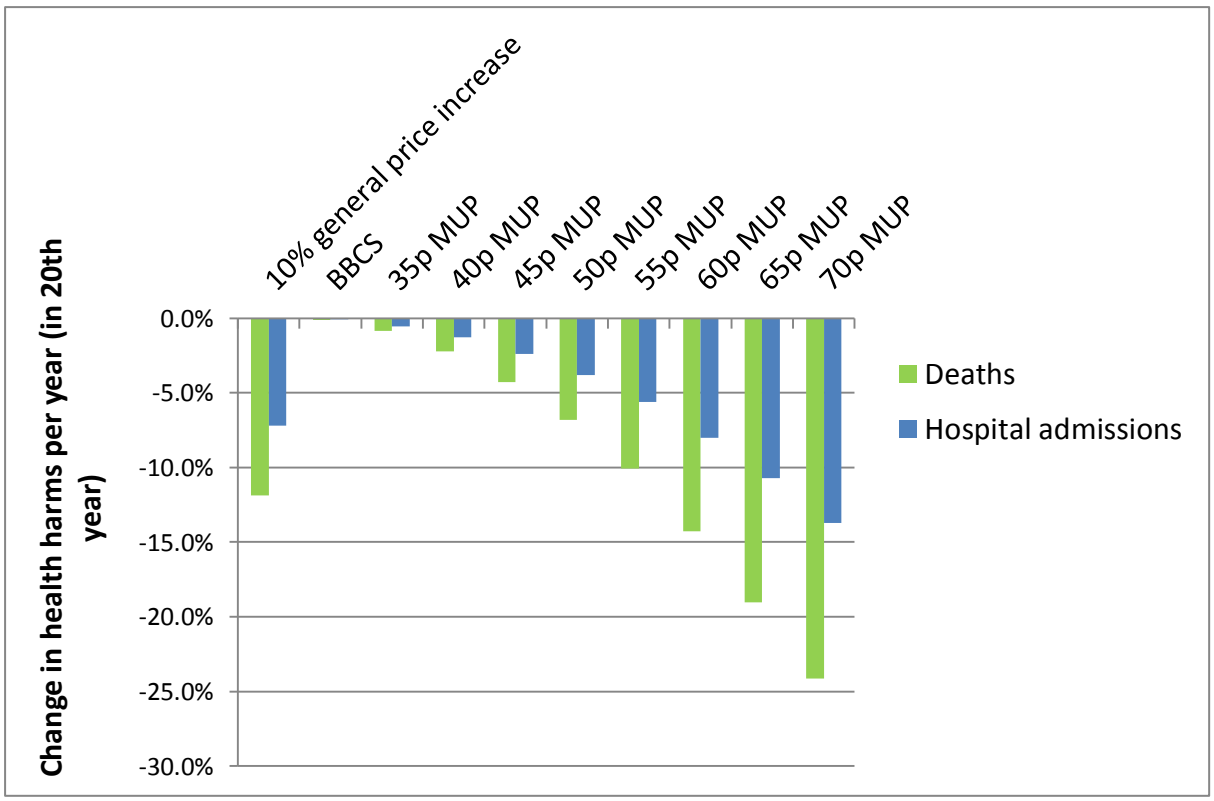


Figure 5.10: Income-specific reduction in deaths per year per 100,000 population at full effect (in 20th years)

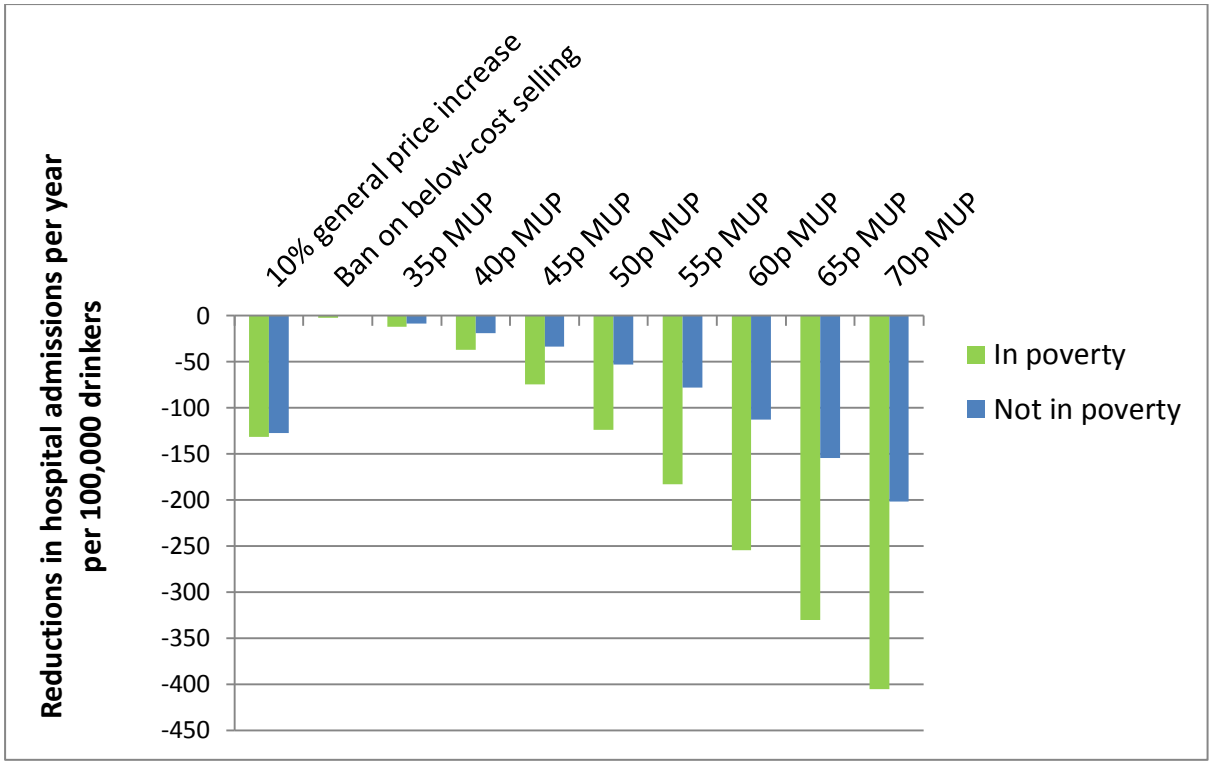


Figure 5.11: Income-specific reductions in hospital admissions per year per 100,000 population

Table 5.8 and Table 5.9 present policy impacts on alcoholic liver disease and sub-categories of health conditions.

Table 5.8: Summary of policy impacts on alcohol liver disease outcomes at full effect (in 20th year)

Policy	**Alcoholic liver disease (ICD-10 code K70)**	
	Deaths per year	Hospital admissions per year
Baseline alcohol-attributable harm volume	-340	-1903
10% general price increase	-28	-158
35p MUP	-3	-16
40p MUP	-7	-41
45p MUP	-13	-77
50p MUP	-21	-119
55p MUP	-30	-171
60p MUP	-41	-234
65p MUP	-54	-302
70p MUP	-66	-373
Ban on below-cost selling	0	-1

Table 5.9: Detailed breakdown of deaths and hospital admissions averted by health condition type for a 50p MUP

Category	Condition	ICD-10 code	Deaths per year (full effect)	Hospital admissions per year (full effect)
Wholly alcohol-attributable	**Alcoholic liver disease**	K70.0-K70.4, K70.9	-21	-119
	Mental and behavioural disorders due to alcohol use	F10	-1	-413
	Other chronic conditions*	E24.4, G31.2, G62.1, G72.1, I42.6, K29.2, K85.2, K86.0, O35.4	-1	-38
	Other acute conditions**	R78.0, T51.0, T51.1, T51.8, T51.9, X45, X65, Y15, Y90	-1	-134
Partially alcohol-attributable	**Cancers**	C00-C15, C18-C22, C32, C50	-16	-46
	Other diseases of the circulatory system	I10-I14, I47-I48, I60-I62, I69.0-I69.2	-2	-416
	Infectious respiratory diseases	A15-A19, B90, J09-J22, J85, P23	-1	-8
	Diseases of the liver and pancreas (excluding wholly-attributable conditions)	K70 (excluding K70.0-K70.4, K70.9), K73-K74, K85-K86 excluding K85.2, K86.0	-4	-31
	Epilepsy and status epilepticus	G40-G41	-1	-43
	Transport injuries (including road traffic accidents)	V01-V98, Y85.0	-3	-52
	Other injuries***	W00-W52, W65-W99, X30-X33, X40-X49 excluding X45, X50-X58, X60-Y09 excluding X65, Y87.0, Y35, Y87.1	-6	-143
Beneficial	**Type II diabetes, ischaemic stroke and ischaemic heart disease**	E10-E14, I20-I25, I63-I67, I69.3	1	23

*Includes degeneration, alcoholic polyneuropathy, alcoholic myopathy, alcoholic cardiomyopathy, alcoholic gastritis, alcoholic liver disease, acute pancreatitis, chronic pancreatitis, maternal care for (suspected) damage to foetus from alcohol.
**Includes excessive blood alcohol, toxic effects of alcohol, poisoning by alcohol (accidental, intentional and undetermined), evidence of alcohol involvement determined by blood alcohol level.
***Includes fall injuries, exposure to mechanical forces (including machinery accidents), drowning, other unintentional Injuries, accidental poisoning by noxious substances, intentional self-harm, assault, other intentional injuries

Table 5.10: Breakdown of deaths and hospital admissions averted over the 20-year course of the model showing estimated effects at years 1 and 20 for all policies.

	Deaths reduction		**Hospital admission reductions**	
	Year 1	Year 20 (full effect)	Year 1	Year 20 (full effect)
Alcohol-attributable harm (burden of disease)[1]	785*	785	37,350*	37,350
Relative change (%)				
10% general price increase	-4.2%	-11.9%	-4.3%	-7.2%
Ban on below-cost selling	0.0%	-0.1%	0.0%	-0.1%
35p MUP	-0.4%	-0.8%	-0.6%	-0.5%
40p MUP	-1.0%	-2.2%	-1.2%	-1.3%
45p MUP	-1.7%	-4.3%	-2.1%	-2.4%
50p MUP	-2.7%	-6.8%	-3.2%	-3.8%
55p MUP	-3.9%	-10.1%	-4.6%	-5.6%
60p MUP	-5.4%	-14.3%	-6.2%	-8.0%
65p MUP	-7.0%	-19.0%	-8.0%	-10.7%
70p MUP	-8.8%	-24.1%	-10.0%	-13.7%
Absolute change				
10% general price increase	-33	-93	-1610	-2681
Ban on below-cost selling	0	-1	-14	-23
35p MUP	-3	-7	-217	-196
40p MUP	-7	-18	-447	-483
45p MUP	-14	-34	-781	-891
50p MUP	-21	-53	-1199	-1422
55p MUP	-30	-79	-1704	-2094
60p MUP	-42	-112	-2320	-2983
65p MUP	-55	-149	-3001	-4007
70p MUP	-69	-190	-3727	-5117

[1] Estimated by modelling a "counterfactual" scenario in which the entire population becomes abstainers, i.e. zero consumption.
*Year-20 value shown as representative of full burden on disease.

5.1.5 Impact on crime outcomes

The estimated impact of the modelled policies on annual volumes of crime is shown in Table 5.11, including the differential impact by drinker group. Relative reductions in crime by drinker group are presented in Figure 5.12. Table 5.12 shows the changes in annual crime volumes further broken down by category of crime.

Table 5.11: Impact of modelled policies on annual crime volumes

	Change in annual crime volumes			
Policy	Population	Moderate	Increasing risk	High risk
Alcohol-attributable harm crime[1]	79971	31851	18072	30048
Relative change (%)				
10% general price increase	-6.3%	-9.4%	-3.9%	-4.4%
Ban on below-cost selling	0.0%	0.0%	0.0%	0.0%
35p MUP	-0.6%	-0.6%	-0.6%	-0.7%
40p MUP	-1.5%	-1.5%	-1.2%	-1.8%
45p MUP	-2.9%	-2.7%	-1.9%	-3.7%
50p MUP	-4.6%	-4.3%	-2.8%	-6.0%
55p MUP	-6.6%	-6.4%	-3.9%	-8.5%
60p MUP	-9.0%	-8.9%	-5.3%	-11.4%
65p MUP	-11.7%	-11.9%	-6.8%	-14.5%
70p MUP	-14.5%	-15.1%	-8.4%	-17.6%
Absolute change				
10% general price increase	-5008	-2986	-702	-1320
Ban on below-cost selling	-13	-1	-4	-8
35p MUP	-510	-202	-103	-206
40p MUP	-1227	-472	-209	-546
45p MUP	-2314	-853	-347	-1115
50p MUP	-3684	-1379	-504	-1801
55p MUP	-5294	-2023	-705	-2565
60p MUP	-7226	-2843	-951	-3432
65p MUP	-9374	-3793	-1232	-4348
70p MUP	-11611	-4809	-1516	-5286

[1] Estimated by modelling a "counterfactual" scenario in which the entire population becomes abstainers, i.e. zero consumption.

Table 5.12: Estimated changes in annual crime volumes by crime category

Policy	Change in annual crime volumes		
	Violent crimes	Criminal damage	Robbery, burglary & theft
Alcohol-attributable harm crime[1]	20880	51837	7253
Relative change (%)			
10% general price increase	-6.6%	-6.1%	-6.2%
Ban on below-cost selling	0.0%	0.0%	0.0%
35p MUP	-0.7%	-0.6%	-0.6%
40p MUP	-1.6%	-1.5%	-1.5%
45p MUP	-3.0%	-2.9%	-2.9%
50p MUP	-4.7%	-4.6%	-4.6%
55p MUP	-6.8%	-6.6%	-6.6%
60p MUP	-9.2%	-8.9%	-9.1%
65p MUP	-12.0%	-11.6%	-11.8%
70p MUP	-14.9%	-14.3%	-14.7%
Absolute change			
10% general price increase	-1370	-3186	-452
Ban on below-cost selling	-4	-8	-1
35p MUP	-142	-323	-45
40p MUP	-333	-785	-109
45p MUP	-623	-1483	-208
50p MUP	-986	-2364	-334
55p MUP	-1414	-3398	-482
60p MUP	-1929	-4638	-660
65p MUP	-2506	-6009	-858
70p MUP	-3110	-7435	-1066

[1] Estimated by modelling a "counterfactual" scenario in which the entire population becomes abstainers, i.e. zero consumption.

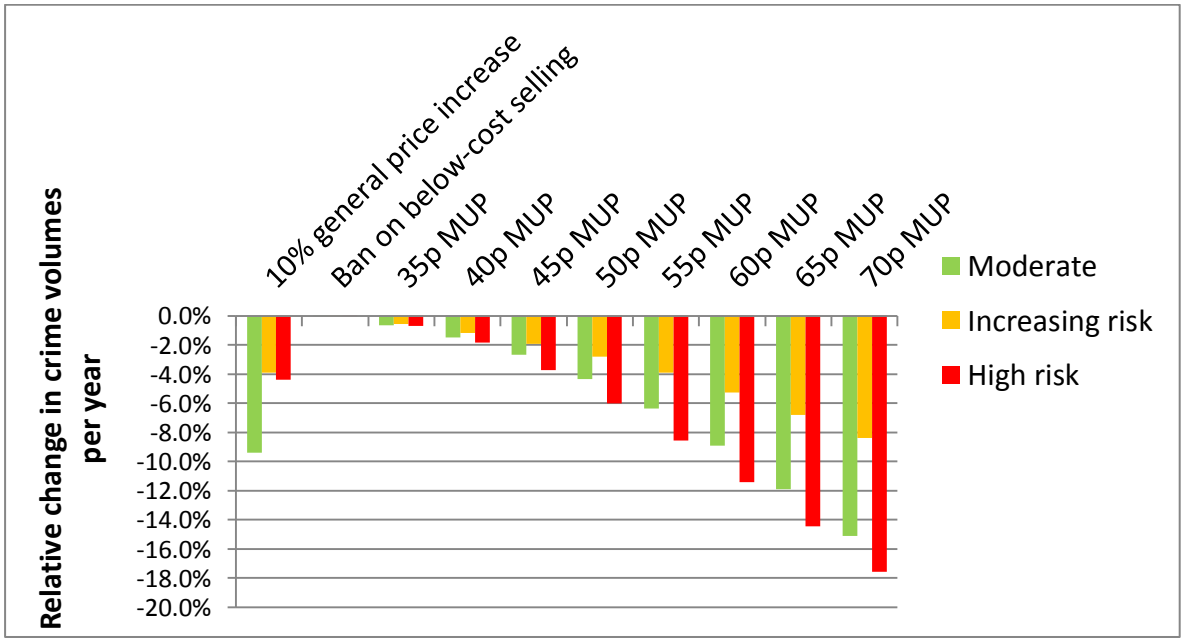


Figure 5.12: Summary of relative changes in alcohol-attributable crime volumes by drinker group

5.1.6 Impact on workplace outcomes

Table 5.13 presents the modelled impact of each policy on the number of days per year lost to workplace absenteeism. Figure 5.13 illustrates this in terms of relative changes in absence days by drinker group.

Table 5.13: Estimated changes in workplace absence

	Change in days absence from work per year			
Policy	Population	Moderate	Increasing risk	High risk
Alcohol-attributable absence ('000)[1]	225	85	75	65
Relative change (%)				
10% general price increase	-6.2%	-8.7%	-3.6%	-6.1%
Ban on below-cost selling	0.0%	0.0%	0.0%	0.0%
35p MUP	-0.7%	-0.5%	-0.4%	-1.3%
40p MUP	-1.6%	-1.2%	-0.8%	-3.0%
45p MUP	-2.9%	-2.2%	-1.4%	-5.5%
50p MUP	-4.6%	-3.7%	-2.2%	-8.7%
55p MUP	-6.7%	-5.6%	-3.2%	-12.2%
60p MUP	-9.2%	-8.1%	-4.5%	-16.1%
65p MUP	-12.0%	-11.0%	-6.0%	-20.2%
70p MUP	-15.0%	-14.2%	-7.6%	-24.4%
Absolute change ('000)				
10% general price increase	-14	-7	-3	-4
Ban on below-cost selling	0	0	0	0
35p MUP	-2	0	0	-1
40p MUP	-4	-1	-1	-2
45p MUP	-7	-2	-1	-4
50p MUP	-10	-3	-2	-6
55p MUP	-15	-5	-2	-8
60p MUP	-21	-7	-3	-10
65p MUP	-27	-9	-4	-13
70p MUP	-34	-12	-6	-16

[1] Estimated by modelling a "counterfactual" scenario in which the entire population becomes abstainers, i.e. zero consumption.

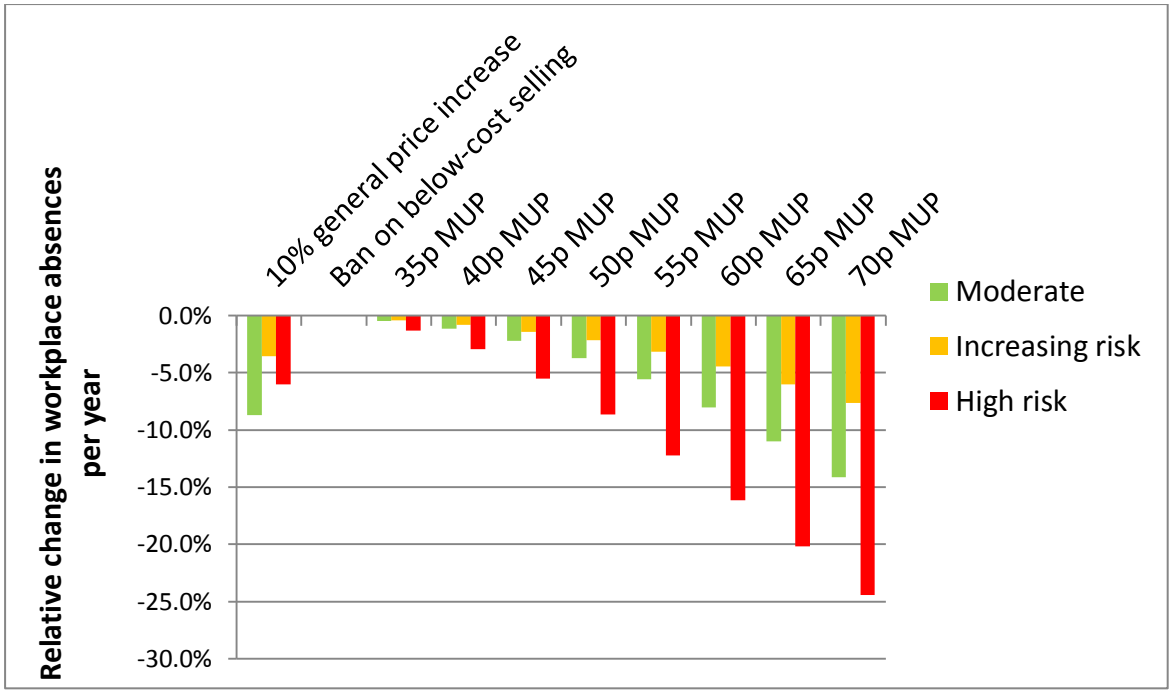


Figure 5.13: Summary of relative changes in annual workplace absence by drinker group

5.1.7 Impact on societal costs

Table 5.14 gives an overview of the estimated annual savings resulting from the implementation of each of the modelled policies. These savings are presented separately for healthcare costs, costs associated with crime and the cost of workplace absenteeism. It should be noted that these costs may not be fully realised in practice as, for example, crime costs incorporate a financial valuation of the impact on the victim.

Table 5.14: Summary of financial impact of modelled policies on health, crime and workplace related harm over 20 years

	Cumulative value of harm reductions over 20 years (discounted)					
Policy	Health direct costs	Health QALYs costs (£60,000 per QALY)	Total health costs	Crime costs	Work absence costs	Total costs
Alcohol-attributable cost (£million, discounted)[1]	2708	7067	9775	5236	290	15301
Relative change (%)						
10% general price increase	-7.6%	-10.3%	-9.5%	-6.7%	-6.6%	-8.5%
BBCS	-0.1%	-0.1%	-0.1%	0.0%	0.0%	-0.1%
35p MUP	-0.8%	-1.1%	-1.0%	-0.7%	-0.7%	-0.9%
40p MUP	-1.7%	-2.5%	-2.3%	-1.6%	-1.6%	-2.0%
45p MUP	-3.1%	-4.5%	-4.1%	-3.0%	-3.0%	-3.7%
50p MUP	-4.8%	-6.9%	-6.3%	-4.7%	-4.7%	-5.8%
55p MUP	-7.0%	-10.0%	-9.1%	-6.8%	-6.9%	-8.3%
60p MUP	-9.5%	-13.7%	-12.6%	-9.2%	-9.3%	-11.3%
65p MUP	-12.5%	-17.9%	-16.4%	-12.1%	-12.4%	-14.9%
70p MUP	-15.8%	-22.4%	-20.6%	-15.0%	-15.5%	-18.6%
Absolute change (£million, discounted)						
10% general price increase	-205	-725	-930	-351	-19	-1300
BBCS	-2	-7	-8	-1	0	-9
35p MUP	-22	-78	-99	-36	-2	-138
40p MUP	-47	-175	-222	-86	-5	-312
45p MUP	-85	-315	-400	-158	-9	-566
50p MUP	-131	-489	-620	-248	-14	-882
55p MUP	-188	-704	-892	-358	-20	-1270
60p MUP	-257	-970	-1228	-480	-27	-1734
65p MUP	-340	-1267	-1606	-635	-36	-2277
70p MUP	-428	-1581	-2009	-788	-45	-2842

[1] Estimated by modelling a "counterfactual" scenario in which the entire population becomes abstainers, i.e. zero consumption.

5.2 EXAMPLE POLICY ANALYSIS A: 50P MUP

This section describes the estimated impacts of a minimum unit price policy of 50p per unit in detail. We assume that this threshold is updated annually in line with inflation. In addition to the results already presented in Table 5.1 to Table 5.14, Table 5.15 to

Table 5.18 show further detailed results for consumption changes, consumer spending and health outcomes.

Across the whole population, 38.4% of units purchased would be affected (i.e. would have their price raised to 50p). The proportion and absolute number of purchased units per week affected for high risk drinkers (46.4% or 36.2 units) is substantially more than for increasing risk drinkers (35.9% or 10.0 units) or moderate drinkers (23.5% or 1.3 units). The proportion and number of purchased units per week affected is higher for those in poverty than those above the poverty line (50.4% and 6.3 units vs. 35.6% and 5.4 units) although this difference is primarily driven by a substantial difference between high risk drinkers in poverty (61.9% or 44.4 units) vs. high risk drinkers not in poverty (43.5% or 34.7 units).

Across the whole population, mean weekly consumption is estimated to change by -4.0%. Weekly consumption reductions are greater for high risk drinkers (-7.2% or 5.6 units) than moderate drinkers (-2.2% or 0.1 units) and for those in poverty (-8.1% or 0.8 units) compared to those not in poverty (-3.0% or 0.4 units).

In both income groups, reductions in consumption are estimated to be small for moderate drinkers and much larger for high risk drinkers. The estimated consumption reduction for moderate drinkers in poverty is -3.9% or 0.1 units per week compared to -13.0% or 9.3 units per week for high risk drinkers in poverty. The corresponding figures for those not in poverty are -1.8% or 0.1 units and -5.8% or 4.7 units.

Across the whole population, estimated spending increases by 1.6% or £10 per drinker per year (£0.19 per week). The cost impact of the policy on consumer spending varies significantly between different drinker and income subgroups. Moderate drinkers are estimated to increase their spending by £2 per year, increasing risk drinkers by £33 per year, and high risk drinkers also by £32. Differences are also observed between income subgroups, with those in poverty spending an extra £5 per year compared to a spending increase of £12 per year for those not in poverty. When we estimate changes in spending by drinker and income subgroups, we observe that high risk drinkers in poverty would increase their spending by £9 compared with high risk drinkers not in poverty who increase their spending by £39. These differing patterns are a result of both the different proportion of each population subgroup's purchases which are affected by the policy as well as the different price elasticities of the beverages which make up a greater or lesser proportion of each subgroup's purchases.

Overall revenue to the Exchequer from duty and VAT receipts is estimated to reduce by 1.0% or £5.8 million. Revenue to retailers is estimated to increase by £25.0 million (12.2%) in the off-trade and £2.0 million (0.3%) in the on-trade. This is as reduced sales volumes are more than offset by the increased value of remaining sales.

Effects on health are estimated to be substantial, with alcohol-attributable deaths estimated to reduce by approximately 53 per year after 20 years, by which time the full effects of the policy will be seen. Reductions in deaths are distributed differentially across drinker groups with 3 saved per year amongst moderate drinkers, 6 amongst increasing risk drinkers and 45 per year amongst high

risk drinkers. Whilst those in poverty see a smaller absolute number of reduced deaths annually (21 vs. 32 for those not in poverty), they also comprise a substantially smaller proportion of the population (24.0%), meaning that the reductions in annual deaths per 100,000 population is considerably greater amongst those in poverty (4.8 vs. 1.9 for those not in poverty).

Similar patterns are observed amongst reductions in alcohol-related hospital admissions, with an estimated 3.8% reduction in admissions per year across the population (1,400 admissions). Admissions reductions for moderate, increasing risk and high risk drinkers are 400, 100 and 900 respectively. Those in poverty experience a smaller absolute reduction in hospital admissions per year (500) than those not in poverty (900), but larger reduction in hospital admission per 100,000 population than those not in poverty (124 vs 53 per 100,000 population).

Crime is estimated to fall by 3,700 offences per year overall. Reductions are concentrated amongst moderate and high risk drinkers with 1,400, 500 and 1,800 fewer offences committed by moderate, increasing risk and high risk drinkers respectively. It should be noted that increasing and high risk drinkers make up a considerably smaller proportion of the population than moderate drinkers. Costs of crime and policing are estimated to reduce by £16.9 million per year.

Workplace absence is estimated to be reduced by 10,000 days per year. This is estimated to lead to an annual saving of almost £0.9 million per year.

The total societal value of these reductions in health, crime and workplace harms is estimated at £882m over the 20 year period modelled. This includes direct healthcare costs (£131m), crime costs (£248m), workplace costs (£14m) and a financial valuation of the QALY gain (£489m), assuming a QALY is valued at £60,000. All costs and benefits are discounted at 3.5%.

Table 5.15: Detailed consumption and spending results for 50p MUP

	Population	Male	Female	Moderate	Increasing risk	High risk	In poverty	Not in poverty
Baseline statistics								
Baseline Consumption (units per week)	12.3	16.9	8.0	4.3	27.8	78.1	9.3	13.2
Population size ('000)	2,490	1,193	1,297	1,955	392	143	591	1,899
Baseline Consumption (drinker)	14.6	19.3	9.9	5.5	27.8	78.1	12.5	15.2
Drinker population ('000)	2,092	1,045	1,048	1,557	392	143	440	1,653
% drinkers	84%	88%	81%	80%	100%	100%	74%	87%
Sales/Consumption volume, units per drinker per year								
Off-beer	109.5	146.6	72.5	28.5	196.2	754.8	126.3	105.0
Off-cider	33.3	48.8	17.8	7.7	44.4	281.3	46.9	29.6
Off-wine	253.7	237.5	269.8	85.3	598.1	1142.9	191.6	270.2
Off-spirits	63.8	82.6	45.0	25.1	82.8	432.8	69.2	62.3
Off-RTDs	3.2	1.7	4.6	1.8	6.7	8.0	2.5	3.4
On-beer	216.9	395.2	39.1	90.1	389.2	1125.8	157.0	232.9
On-cider	15.2	24.3	6.2	6.0	26.5	84.9	9.9	16.7
On-wine	31.7	38.6	24.8	19.6	60.3	84.3	18.9	35.1
On-spirits	18.3	17.5	19.1	14.4	17.9	62.3	22.1	17.3
On-RTDs	16.1	15.0	17.3	5.9	27.4	96.0	7.7	18.3
Total	**761.7**	**1007.8**	**516.2**	**284.4**	**1449.6**	**4073.0**	**652.1**	**790.8**
Spending, £ per drinker per year								
Off-beer	49.5	67.3	31.7	14.1	90.3	323.1	53.8	48.3
Off-cider	12.3	17.1	7.4	3.1	16.9	100.0	13.9	11.8
Off-wine	143.1	139.8	146.5	49.1	340.8	625.4	89.2	157.5
Off-spirits	26.1	31.0	21.3	10.5	41.0	156.1	5.8	31.5
Off-RTDs	2.6	1.0	4.2	1.6	4.9	7.4	1.6	2.9
On-beer	261.7	476.6	47.3	118.9	451.0	1297.8	159.9	288.7
On-cider	17.9	28.5	7.3	7.1	31.7	97.8	10.1	20.0
On-wine	64.9	78.8	51.1	47.1	122.1	102.0	18.9	77.2
On-spirits	45.7	42.0	49.4	42.2	39.8	100.4	30.8	49.7
On-RTDs	27.9	23.4	32.5	11.6	49.2	147.8	10.5	32.6
Total	**651.7**	**905.4**	**398.7**	**305.0**	**1187.7**	**2957.8**	**394.7**	**720.1**
After intervention / Change from baseline								
Changes in consumption (units)	-0.5	-0.8	-0.2	-0.1	-0.6	-5.6	-0.8	-0.4
Changes in consumption (%)	-4.0%	-4.5%	-2.8%	-2.2%	-2.0%	-7.2%	-8.1%	-3.0%
Final Consumption (drinker)	14.0	18.5	9.6	5.3	27.2	72.5	11.5	14.7
Absolute change in sales/Consumption volume, units per drinker per year								
Off-beer	-18.0	-22.2	-13.8	-2.9	-26.9	-157.5	-26.3	-15.7
Off-cider	-13.8	-20.9	-6.7	-2.5	-21.8	-115.1	-19.9	-12.2
Off-wine	10.4	13.4	7.3	2.1	29.7	47.3	5.9	11.6
Off-spirits	-6.7	-10.5	-2.9	-1.8	-6.5	-61.0	-9.5	-6.0
Off-RTDs	-0.5	-0.4	-0.7	-0.2	-1.1	-2.6	-0.7	-0.5
On-beer	-5.2	-9.7	-0.7	-2.1	-9.2	-28.4	-4.7	-5.4
On-cider	0.5	0.9	0.2	0.1	1.4	2.9	0.3	0.6
On-wine	2.0	2.8	1.3	1.0	4.0	8.0	1.3	2.2
On-spirits	-0.3	-0.4	-0.1	-0.3	-0.3	0.0	0.0	-0.3
On-RTDs	1.4	1.4	1.4	0.2	2.0	13.2	0.6	1.6
Total	**-30.2**	**-45.7**	**-14.7**	**-6.4**	**-28.8**	**-293.2**	**-53.0**	**-24.1**
Absolute change in spending, £ per drinker per year								
Off-beer	-0.6	-0.4	-0.8	0.0	0.4	-10.1	-1.8	-0.3
Off-cider	-3.2	-4.8	-1.5	-0.6	-5.2	-26.0	-4.5	-2.8
Off-wine	14.1	15.0	13.1	3.8	35.2	67.5	12.1	14.6
Off-spirits	-0.7	-1.4	0.0	-0.2	-0.1	-8.1	0.2	-0.9
Off-RTDs	-0.4	-0.2	-0.7	-0.2	-0.7	-2.4	-0.4	-0.4
On-beer	-5.6	-10.7	-0.5	-2.6	-10.0	-26.7	-3.6	-6.1
On-cider	0.6	1.1	0.2	0.1	1.8	3.4	0.4	0.7
On-wine	3.9	5.3	2.4	2.3	8.3	8.6	1.5	4.5
On-spirits	-0.7	-0.9	-0.5	-0.8	-0.4	-0.7	0.0	-0.9
On-RTDs	2.7	2.7	2.8	0.4	3.4	26.9	1.0	3.2
Total	**10.14**	**5.69**	**14.58**	**2.37**	**32.88**	**32.35**	**4.88**	**11.54**

Table 5.16: Detailed income- and drinker group-specific results for 50p MUP

	In poverty			Not in poverty		
	Moderate	Increasing risk	High risk	Moderate	Increasing risk	High risk
Baseline statistics						
Baseline Consumption (units per week)	3.4	25.9	71.7	4.7	28.2	79.8
Population size ('000)	496	65	29	1,458	327	113
Baseline Consumption (drinker)	4.9	25.9	71.7	5.6	28.2	79.8
Drinker population ('000)	345	65	29	1,212	327	113
% drinkers	70%	100%	100%	83%	100%	100%
Sales/Consumption volume, units per drinker per year						
Off-beer	36.0	279.5	848.8	26.3	179.7	730.4
Off-cider	8.6	86.2	410.3	7.4	36.2	247.9
Off-wine	82.2	397.6	1022.0	86.1	637.8	1174.1
Off-spirits	28.4	79.0	527.2	24.2	83.6	408.4
Off-RTDs	2.1	4.5	2.9	1.8	7.2	9.3
On-beer	68.0	360.4	753.3	96.4	394.9	1222.3
On-cider	6.1	33.9	1.5	6.0	25.0	106.4
On-wine	11.6	54.0	26.7	21.9	61.5	99.2
On-spirits	11.9	33.5	116.4	15.1	14.9	48.3
On-RTDs	3.2	22.4	28.2	6.7	28.4	113.6
Total	**258.1**	**1350.8**	**3737.3**	**291.9**	**1469.1**	**4159.9**
Spending, £ per drinker per year						
Off-beer	16.9	122.1	336.4	13.3	84.0	319.7
Off-cider	4.0	30.1	95.2	2.8	14.2	101.3
Off-wine	36.5	195.3	473.3	52.6	369.6	664.8
Off-spirits	3.6	19.7	1.3	12.4	45.2	196.1
Off-RTDs	2.1	n/a[1]	n/a[1]	1.5	5.8	9.3
On-beer	73.1	391.5	668.2	131.9	462.8	1460.8
On-cider	6.6	33.6	n/a[1]	7.2	31.3	123.1
On-wine	15.6	33.3	26.8	56.1	139.8	121.4
On-spirits	31.0	43.5	0.4	45.3	39.1	126.2
On-RTDs	5.6	41.4	n/a[1]	13.3	50.8	186.1
Total	**194.9**	**910.4**	**1601.7**	**336.4**	**1242.7**	**3308.8**
After intervention / Change from baseline						
Changes in consumption (units)	-0.1	-1.6	-9.3	-0.1	-0.3	-4.7
Changes in consumption (%)	-3.9%	-6.2%	-13.0%	-1.8%	-1.2%	-5.8%
Final Consumption (drinker)	4.8	24.3	62.3	5.5	27.8	75.1
Absolute change in sales/Consumption volume, units per drinker per year						
Off-beer	-6.0	-49.6	-213.1	-2.0	-22.3	-143.1
Off-cider	-2.5	-38.8	-183.1	-2.5	-18.4	-97.5
Off-wine	1.6	14.1	38.1	2.3	32.8	49.6
Off-spirits	-2.3	-6.2	-101.8	-1.7	-6.5	-50.4
Off-RTDs	-0.5	-1.2	-0.8	-0.1	-1.1	-3.0
On-beer	-1.7	-9.2	-29.1	-2.2	-9.2	-28.3
On-cider	0.1	1.8	0.0	0.1	1.3	3.7
On-wine	0.9	3.5	1.7	1.0	4.1	9.6
On-spirits	0.0	-0.5	0.8	-0.4	-0.3	-0.2
On-RTDs	0.4	1.9	0.0	0.1	2.0	16.6
Total	**-10.1**	**-84.3**	**-487.3**	**-5.3**	**-17.7**	**-243.0**
Absolute change in spending, £ per drinker per year						
Off-beer	-0.4	-1.5	-18.6	0.1	0.8	-7.8
Off-cider	-0.5	-8.0	-43.2	-0.6	-4.6	-21.6
Off-wine	3.2	28.0	82.0	4.0	36.7	63.7
Off-spirits	0.0	0.8	0.0	-0.2	-0.3	-10.3
Off-RTDs	-0.5	n/a	n/a	-0.1	-0.8	-3.0
On-beer	-1.6	-9.7	-13.9	-2.8	-10.0	-30.0
On-cider	0.1	2.3	0.0	0.1	1.7	4.3
On-wine	1.2	2.7	2.2	2.7	9.5	10.3
On-spirits	-0.1	0.3	0.0	-1.0	-0.5	-0.9
On-RTDs	0.7	2.9	0.0	0.3	3.5	33.8
Total	**2.15**	**17.74**	**8.50**	**2.44**	**35.88**	**38.52**

Remarks: 1: no robust estimates of spending and price per unit can be obtained because there are fewer than 5 Welsh alcohol-purchase transactions in the Living Cost and Food Survey 2001-2009 for the specific beverage type and the population subgroup (e.g. off-trade RTD for high risk drinkers in poverty).

Table 5.17: Relative changes in price, consumption and spending, by beverage type and location for 50p MUP

	Change in price	Change in consumption	Change in spending
Off-beer	18.7%	-16.4%	-1.2%
Off-cider	33.3%	-41.4%	-25.8%
Off-wine	5.7%	4.1%	9.8%
Off-spirits	8.6%	-10.5%	-2.7%
Off-RTDs	0.0%	-17.1%	-16.1%
Subtotal: off-trade	**10.6%**	**-6.2%**	**3.9%**
On-beer	0.2%	-2.4%	-2.1%
On-cider	0.3%	3.3%	3.5%
On-wine	0.0%	6.5%	6.0%
On-spirits	0.1%	-1.4%	-1.5%
On-RTDs	0.0%	8.6%	9.8%
Subtotal: on-trade	**0.2%**	**-0.5%**	**0.2%**
Total	**4.6%**	**-4.0%**	**1.6%**

Remarks: Prices are almost unaffected for off-RTDs and on-trade beverages; and the changes in the consumption for these beverages are driven by the price reductions of off-beer, cider, wine and spirits through cross-price elasticities shown in Table 4.3.

Table 5.18: Detailed health outcomes by drinker group and income for 50p MUP

	Population	Moderate	Increasing risk	High risk	In poverty	Not in poverty
Baseline alcohol-attributable deaths per year	785	-225	319	692	214	571
Changes in deaths per year	-53	-3	-6	-45	-21	-32
% change in deaths	-6.8%	n/a[1]	-1.8%	-6.5%	-9.9%	-5.6%
Baseline alcohol-attributable hospital admissions per year ('000)	37.3	5.2	14.2	17.9	8.3	29.1
Change in hospital admissions per year ('000)	-1.4	-0.4	-0.1	-0.9	-0.5	-0.9
% change in hospital admissions	-3.8%	-7.1%	-0.8%	-5.2%	-6.6%	-3.0%
Health direct costs saved per year (£million in 20th year, discounted)	-4.2	-1.1	-0.4	-2.8	-1.7	-2.5
QALYs saved per year (in 20th year, discounted)	458	130	47	281	194	264

Remarks: 1: % change in death is not calculated because the baseline alcohol-attributable deaths per year for moderate drinkers is negative (i.e., overall protective effect for moderate drinkers).

5.3 SENSITIVITY ANALYSES

The results of the 3 sensitivity analyses described in Section 4.7 are presented in Table 5.19 and Figure 5.14 (for the impacts on alcohol consumption) and Table 5.20 and Figure 5.15 (for the impacts on harm outcomes) for a 50p MUP policy. The results suggest that the base case model is relatively conservative in terms of estimated scale of impact for the overall population when compared to the alternative sensitivity analyses. All other scenarios lead to greater estimates of alcohol consumption reduction than the base case, in all drinker groups and for those in poverty and otherwise. The effects of the different sensitivity analyses are not uniform across subgroups, for example SA1 shows a smaller impact on those in poverty and moderate drinkers, while SA3 shows a greater impact on increasing risk and high risk drinkers.

Table 5.19: Comparison of estimated impacts on alcohol consumption for a 50p MUP using alternative elasticity estimates

	50p MUP: alternative elasticities			
	Base case	SA1 - No cross-price	SA2 - No non-significant	SA3 - Consumption level-specific
Population	-4.0%	-5.3%	-5.1%	-5.7%
Moderate	-2.2%	-2.7%	-2.5%	-1.5%
Increasing risk	-2.0%	-4.6%	-4.5%	-6.0%
High risk	-7.2%	-7.8%	-7.6%	-8.6%
In poverty	-8.1%	-8.7%	-8.3%	-8.0%
Not in poverty	-3.0%	-4.5%	-4.4%	-5.2%

Figure 5.14: Comparison of estimated impacts on alcohol consumption of a 50p MUP policy using alternative elasticity estimates

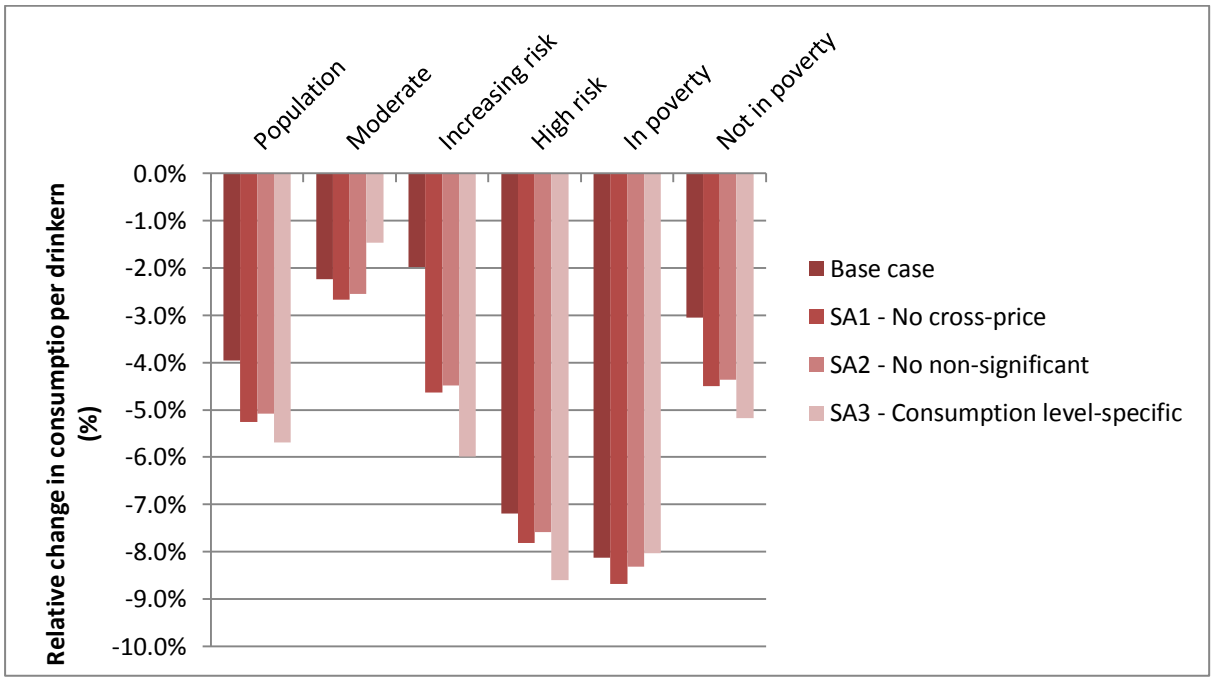
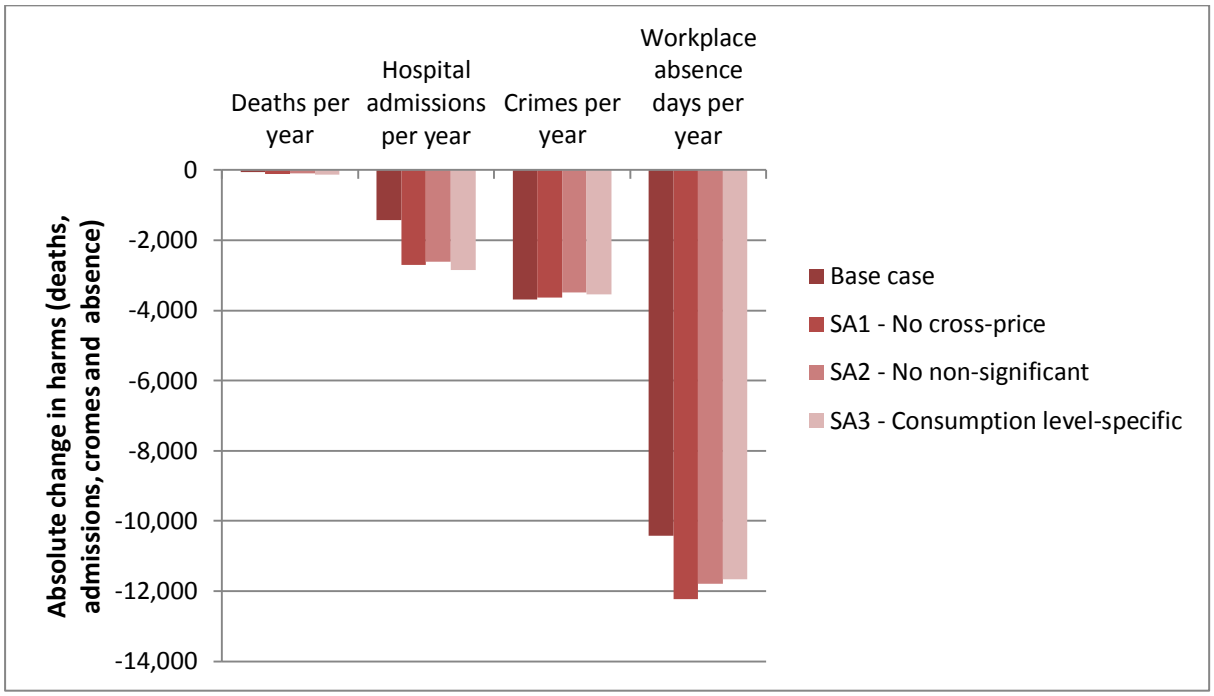


Table 5.20: Comparison of estimated impacts on harm outcomes of a 50p MUP using alternative elasticities

		Harm reductions in year 20			
		Deaths per year	Hospital admissions per year	Crimes per year	Workplace absence days per year
50p MUP	Base case	-53	-1,422	-3,684	-10,427
	SA1 - No cross-price	-102	-2,702	-3,626	-12,230
	SA2 - No non-significant	-98	-2,606	-3,481	-11,783
	SA3 - Consumption level-specific	-121	-2,854	-3,539	-11,664

Figure 5.15: Comparison of estimated impacts on alcohol related harms of a 50p MUP policy using alternative elasticity estimates



6 DISCUSSION

This research study presents the synthesis of evidence available to undertake policy appraisal of 10 options for price regulation of alcohol in Wales. In this discussion section, we draw out key themes and findings from the detailed analysis.

6.1 DIFFERENTIAL POLICY IMPACTS

We have examined 8 policy options for a minimum price threshold ranging from 35p to 70p per unit of alcohol. The estimated per person reduction in alcohol consumption for the overall population ranges from 0.7% to 12.3% for a MUP policy with thresholds set from 35p to 70p per unit of alcohol, with higher MUP thresholds leading to greater reductions in consumption. These consumption reductions lead to estimated reductions in deaths from 7 to 190 per year, hospital admissions from 200 to 5,100 per year, crime from 500 to 11,600 per year and days absence from work from 2,000 to 34,000 per year for a MUP policy with thresholds set from 35p to 70p per unit of alcohol, again with higher MUP thresholds leading to greater reductions in alcohol-related harms. Specifically, a 50p MUP policy is estimated to reduce per person alcohol consumption by 4.0% and lead to 53 fewer deaths, 1,400 fewer hospital admissions, 3,700 fewer crimes and 10,000 fewer absent days in Wales per year.

In contrast, a policy to ban below-cost selling has virtually no impact on consumption and alcohol-related harms because most alcohol sold in the market would not be affected by the policy.

A policy of a general price increase of 10% is estimated to reduce consumption by 5.2% (roughly equivalent impact to that of a MUP of between 50 and 55p). It would have a slightly lesser impact on spending than a 50-55p MUP, but a slightly greater impact on hospital admissions and deaths. The impact on crime and absenteeism is estimated to be roughly the same as a 50 to 55p MUP.

In summary, MUP policies are estimated to reduce alcohol consumption and alcohol-related mortality, hospital admissions, crime and days absent from work in Wales and the higher the threshold of MUP is set, the greater the reduction in alcohol consumption and alcohol-related harms.

6.2 IMPACTS BY DRINKER GROUP

In line with findings from previous studies in England, Scotland and Canada, this analysis shows that MUP is policy targeted at increasing risk and high risk drinkers. The main reason for this is that high risk drinkers tend to favour the cheaper alcohol that is most affected by MUP policies. See, for example, Figure 4.9 that shows that high risk drinkers buy more than a third of their alcohol at below 50p per unit, whereas moderate drinkers buy less than a quarter of their alcohol below this threshold.

A 50p MUP is estimated to reduce alcohol consumption by 2.2%, 2.0% and 7.2% for moderate, increasing risk and high risk drinkers respectively. The absolute reduction in alcohol units consumed is estimated at just 6.4 per year for moderate drinkers, 28.8 per year for increasing risk, and 293.2 per year for high risk drinkers. So it is the high risk drinkers who are most affected in terms of scale of consumption reduction.

This in turn is reflected in the harm reductions for the 50p MUP policy. High risk drinkers, whilst only making up 5.7% of the population, contribute to 45 out of 53 (85%) and 900 out of 1,400 (64%) estimated annual reductions in deaths and hospital admissions for a 50p MUP policy.

6.3 IMPACTS BY INCOME

The analyses also present income-specific results from SAPM3 for Wales and five main findings should be highlighted.

First, when interpreting these results, it should be borne in mind that 26% of those in poverty are non-drinkers compared to 13% of those not in poverty and, amongst moderate drinkers, those in poverty consume 4.9 units per week compared to 5.6 units for those not in poverty. Therefore, the subgroup of the population which is in poverty contains a disproportionate number of people who will be wholly or largely unaffected by the direct impacts of MUP due to their abstinence or relatively low consumption.

Second, MUP impacts on the consumption of both in poverty and not in poverty income groups; however, it has a greater relative impact on the consumption of drinkers in poverty. As we assume drinkers in poverty and not in poverty are equally responsive to price changes when they have the same consumption patterns, this difference in estimated policy impact is due to 1) drinkers in poverty tending to buy more products from the cheaper end of the spectrum, and 2) the larger price elasticities of the products favoured by drinkers in poverty, particularly beer and cider purchased in the off-trade.

Third, the impact of a 50p MUP on some groups is very small in absolute terms. Consumption amongst moderate drinkers in poverty and not in poverty respectively would fall by just 10.1 and 5.3 units per year. This compares with an average reduction of 487.3 units for in poverty high risk drinkers and 243.0 units for not in poverty high risk drinkers.

Fourth, the impact of a MUP on drinkers in poverty's spending is smaller overall, and within each consumption group, than the impact on drinkers who are not in poverty's spending. This is because the products favoured by drinkers not in poverty have smaller price elasticities and thus, although drinkers not in poverty do reduce their consumption, they are also more likely to increase their spending in response to price increases.

Finally, the greater fall in consumption amongst drinkers in poverty also leads to greater reductions in alcohol-related health harms within this group. For a 50p MUP, the estimated reductions in deaths are 9.9% and 5.6% for drinkers in poverty and not in poverty respectively. For hospital admissions, the estimated reductions are 6.6% and 3.0% for drinkers in poverty and not in poverty.

In summary, the income-specific analysis of the potential impacts of a 50p MUP suggests that MUP will impact on both drinkers in poverty and not in poverty and that, within each income group, the impacts on high risk drinkers will be substantial and greater than the impacts on moderate drinkers. A key policy concern is whether moderate drinkers in poverty are 'penalised' by MUP. Policy impacts on moderate drinkers in poverty are small in absolute terms, amounting to a consumption reduction of just 10.1 units per year and a spending increase of just £2 per year. As moderate consumers make up 84% of the in poverty population and 30% of these are abstainers and thus not directly affected

by the policy, our estimates suggest only a small minority of those in poverty will be substantially impacted by MUP and these individuals will be those who, though in poverty, consume at increasing risk or high risk levels. The greater health benefits of MUP for lower income drinkers suggest the policy may also contribute to the reduction of health inequalities.

6.4 IMPACTS ON REVENUE TO THE EXCHEQUER AND RETAILERS

When prices and consumption change then the revenue to government will change also because duty is levied on amount of ethanol content (e.g. beer and spirits) or product volume (e.g. wine and cider) that is sold, and VAT is charged on the sales value.

A 50p MUP is estimated to lead to an overall decrease in revenue for the Exchequer of £5.8 m (1.0%), with a decrease in duty plus VAT revenue from the off-trade of £5.7m (2.0%) and almost no change from the on-trade of £0.0m (0.0%). The decrease in duty plus VAT revenue from the off-trade is mainly due to the decrease in off-trade duty receipts which are directly linked to the reduction in alcohol consumption, as duty is levied on either ethanol content (e.g. beer and spirits) or product volume (e.g. wine and cider).

Retailers' revenues are affected to larger extent than those of government. A 50p MUP is estimated to lead to an overall increase in revenue for retailers of £27.0m (3.3%), with increase in revenue for off-trade retailers of £25.0m (12.2%) and for on-trade retailers of £2.0m (0.3%).

The relative inelasticity of alcohol (see Table 4.3 where most estimated own-price elasticities are smaller than 1) means that the average consumer response to alcohol price increases includes paying more as well as buying less, and when elasticities are less than 1, spending and hence revenue to retailers increases even though consumption falls.

Table 4.3 also shows that there is a mix of positive and negative cross-price elasticities of demand for on-trade beverages with regard to off-trade prices, and the magnitude of these cross-price elasticities are smaller than the own-price elasticities. This leads to the small increase in revenue for on-trade retailers even though the prices of products in the on-trade are largely unaffected by the policy.

Caution is required regarding the estimated impacts on revenue for on-trade due to the lack of statistical significance for many of the cross-price elasticities.

It should also be noted that considerable uncertainty exists regarding retailers' responses to the introduction of a MUP. SAPM3 assumes the only change in pricing that will occur is for all prices of products below the MUP threshold to be raised up to that threshold. In reality, retailers and producers may make a range of additional changes to both prices and products which may impact on resulting revenue changes to the Exchequer and retailers and other modelled outcomes.

6.5 IMPACTS ON ALCOHOL-RELATED HEALTH

A 50p MUP policy is estimated to lead to 53 fewer deaths, 1,400 fewer hospital admissions and save the Health Service £131 million over 20 years, with higher MUP thresholds providing even greater benefits.

These figures are likely to underestimate the true impact as the morbidity data is based on hospital in-patient admissions data and therefore excludes patients presenting at either Accident and Emergency (A&E) departments or in primary care who do not subsequently go on to attend hospital for the same condition. This is particularly likely to lead to an underestimate of the true prevalence of some acute health conditions such as ethanol poisoning or falls where patients are more likely to be treated at A&E and then sent home directly. However this may be mitigated to some extent by the fact that the number of alcohol-related hospital admissions is estimated based on the inclusion of each alcohol-related condition as a primary or secondary diagnosis in the patient's records, rather than solely a primary diagnosis. Whilst this may result in an overestimation of the true number of hospital admissions which are attributable to alcohol, it is generally accepted as best practice when seeking to quantify the total burden of alcohol on the Health Service [33]. It is also likely that the cost savings to the Health Service are underestimated as they do not include any A&E or primary care related costs, both of which are likely to reduce to some extent following the introduction of any of the modelled policies.

Finally, it should be noted that the existing evidence on the temporal relationship between changes in alcohol consumption and changes in risk is relatively limited. For those chronic health conditions for which no evidence could be identified we have assumed that the change in risk is linear over 20 years. This is likely to be conservative as the available evidence for other conditions suggests that the greatest reduction in risk occurs in the years immediately after the change in consumption [28].

6.6 IMPACTS ON ALCOHOL-RELATED CRIME

A 50p MUP is estimated to lead to 3,700 fewer crimes. High risk drinkers, who comprise around 5.7% of the population, account for 49% of this reduction. Costs of crime are estimated to reduce by £248 million over 20 years under this policy, with higher MUP thresholds providing even greater savings (e.g. £788 million for a 70p MUP).

6.7 IMPACTS ON WORK ABSENCE

Workplace absence is estimated to fall under all modelled policies, with a reduction of 10,000 days absent per year for a 50p MUP, valued at £14m over 20 years.

6.8 COST IMPACTS ON SOCIETY

A 50p MUP is estimated to lead to a cumulative saving to society of £882 million over 20 years from reductions in direct health costs (£131 million), crime costs (£248 million), reduced workplace absence (£14 million) and gains in societal health QALYs (£489 million). It should be noted that these figures do not include the potential productivity gain to society of those people who live longer or in better health as a result of the policy.

6.9 STRENGTHS AND LIMITATIONS

This work to estimate the impact of minimum unit price for alcohol in Wales has three key strengths.

First, the model uses the best and most recent Welsh specific evidence available to the research team. This includes alcohol consumption and demographic information from the GLF, alcohol purchase transactions and prices paid from the LCF, NHS Wales hospital admissions data and ONS Wales specific mortality data, and Welsh specific crime rates from the Home Office and work absence rates from the LFS. In particular, the hospital admission and mortality data is robust as this is very recent data specially requested and provided by the NHS Wales Information Service and the Office for National Statistics for this analysis.

Second, the SAPM itself is a strength of the work. The model has been used to estimate the impact of MUP in countries including England and Scotland, and has been published in peer-reviewed journals (e.g. 1-3, 5, 6). The version of the model used here, SAPM3, has several key developments compared to previous versions of the model. This includes updated own- and cross-price elasticities for alcohol using most recent UK data, updated relative risk functions for chronic harm taken from a recent meta-analysis (see Table 4.6), updated time lags for chronic health conditions (32), and a new method for modelling partially attributed acute harm (traffic and non-traffic injuries) (31).

Third, conservative assumptions are made in general when faced with data limitations or uncertainty. The sensitivity analysis shows that the base case elasticity matrix chosen gives most conservative results for reductions in alcohol consumption and alcohol-related harm. A conservative approach was used when estimating time lags for the delayed impact of consumption on health conditions. This, combined with 3.5% per annum discounting for costs and QALYs, means cost savings estimates at full effect (in year 20) and cumulative savings over 20 years are also likely to be conservative. Additionally, some areas of alcohol related harm have not been considered in this version of the model, for example, harms to others such as children and partners.

However, there are a number of limitations that should be highlighted in relation to this work. Broadly, these include the use of consumption data for Wales from the GLF 2008 to 2011, the absence of most recent Welsh specific Nielsen off-trade price distribution data, the relative weakness of evidence for modelling crime and absenteeism and time lag for chronic health harms, and peripheral factors that may influence the estimates but out of the scope of the current model.

First, the alcohol consumption data used in the model is the Welsh specific data within the GLF for October 2008 to September 2011. It should be acknowledged that alcohol consumption patterns are changing over time and therefore this data may not accurately represent the current Welsh alcohol consumption level and pattern. We have not used the more recent Welsh Health Survey 2012 which also has a bigger sample size. This is because the survey does not record mean alcohol consumption for the survey respondents which is essential for modelling the relationship between alcohol and a range of health conditions such as liver diseases, various cancers and diseases of the circulatory system. Linked to this limitation is that self-reported alcohol consumption, such as that used in the GLF, is often under-recorded for reasons including recall bias and mismeasurement. Certain higher-risk groups, such as the homeless, can also be under-represented in household surveys. Therefore it is plausible that the consumption recorded in GLF is an underestimate of actual Welsh consumption. The issue of under-recording should not have a large impact on estimated relative changes in consumption and alcohol-related harms. But, estimated absolute reductions in consumption and

harms may be underestimated as previous analysis shows that baseline alcohol-attributable mortality and morbidity for partially attributable chronic health conditions are underestimated using under-recorded survey data (39). If this is true, then estimated consumption and harm reductions in this analysis without upshifting the under-recorded survey consumption is conservative in nature.

Second, the model does not use the most recent Wales specific Nielsen data for price distributions in the off-trade. Instead, Nielsen off-trade price distributions data for England and Wales combined for 2012, which is publicly available data (8), is used to adjust the raw price distributions from the LCF. To preserve the relative price paid differences between England and Wales, the raw LCF data including both England and Wales records were adjusted together to the Nielsen 2012 England and Wales data. Then we retained just the Welsh adjusted prices for use in this analysis. We also adjusted prices to 2014 prices. Despite these measures, there may be still nuances in the overall off-trade price distributions that could have been identified using the latest Wales specific Nielsen data.

Third, whilst the evidence and data used within the consumption to health harms part of the model is strong, the evidence for the crime and absenteeism parts of the model is less so because previous work examining the linkage between both alcohol consumption and crime harms, and alcohol consumption and workplace absenteeism, is more limited. However, the model does make use of the best available evidence.

Fourth, the model is built to estimate mortality and morbidity impacts for chronic health harms over a 20-year period, with different health conditions given different lags between consumption change and health risk change. The time lags built into the model are based on relatively scarce evidence and so are subject to uncertainty.

Finally, there are some general model limitations and other factors that may influence the estimates. The model does not consider issues such as cross-border trade or illicit trade as there is no literature or data to support building such components in to the model.

7 REFERENCES

1. Purshouse R, Brennan A, Latimer N, Meng Y, Rafia R, Jackson R, et al. Modelling to assess the effectiveness and cost-effectiveness of public health related strategies and interventions to reduce alcohol attributable harm in England using the Sheffield Alcohol Policy Model version 2.0. Report to the NICE Public Health Programme Development Group. Sheffield; 2009.
2. Meng Y, Hill-McManus D, Brennan A, Meier P. Model-Based Appraisal of Alcohol Minimum Pricing and off-Licensed Trade Discount Bans in Scotland using the Sheffield Alcohol Policy Model (v.2): Second update based on newly available data. Report to the Scottish Government. Sheffield; 2012.
3. Hill-McManus D, Brennan A, Stockwell T, Giesbrecht N, Thomas G, Zhao J, et al. Model-Based Appraisal Of Alcohol Minimum Pricing In Ontario And British Columbia: A Canadian adaptation of the Sheffield Alcohol Policy Model Version 2 [Internet]. 2012. Available from: http://www.carbc.ca/Portals/0/PropertyAgent/558/Files/240/AlcMinPricingOntBC.pdf
4. Angus C, Scafato E, Ghirini S, Torbica A, Ferre F, Struzzo P, et al. Cost-effectiveness of a programme of screening and brief interventions for alcohol in primary care in Italy. BMC Fam Pract [Internet]. 2014 Jan [cited 2014 Mar 7];15(1):26. Available from: http://www.biomedcentral.com/1471-2296/15/26
5. Meng Y, Brennan A, Holmes J, Hill-McManus D, Angus C, Purshouse R, et al. Modelled income group-specific impacts of alcohol minimum unit pricing in England 2014/15: Policy appraisals using new developments to the Sheffield Alcohol Policy Model (v2.5) [Internet]. 2013. Available from: https://www.shef.ac.uk/polopoly_fs/1.291621!/file/julyreport.pdf
6. Holmes J, Meng Y, Meier PS, Brennan A, Angus C, Campbell-Burton A, et al. Effects of minimum unit pricing for alcohol on different income and socioeconomic groups: a modelling study. Lancet [Internet]. 2014 May 10 [cited 2014 May 25];383(9929):1655–64. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4018486&tool=pmcentrez&rendertype=abstract
7. Office for National Statistics. Consumer Price Inflation Reference Tables [Internet]. 2014. Available from: http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm:77-323581\
8. NHS Health Scotland. MESAS Alcohol Sales Update 2013. 2014. Available from: http://www.healthscotland.com/documents/21782.aspx.
9. Meng Y, Brennan A, Purshouse R, Hill-McManus D, Angus C, Holmes J, et al. Estimation of own and cross price elasticities of alcohol demand in the UK-A pseudo-panel approach using the Living Costs and Food Survey 2001-2009. J Health Econ [Internet]. 2014 Mar;34:96–103. Available from: http://www.sciencedirect.com/science/article/pii/S0167629613001835
10. Rehm J, Baliunas D, Borges G. The relation between different dimensions of alcohol consumption and burden of disease: an overview. Addiction. 2010;105(5):817–43.
11. Rehm J, Mathers C. Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. Lancet. 2009;373:2223–33.
12. Lonnroth K, Williams BG, Stadlin S, Jaramillo E, Dye C. Alcohol use as a risk factor for tuberculosis - a systematic review. *Bmc Public Health* 2008; 8.
13. Tramacere I, Negri E, Bagnardi V, Garavello W, Rota M, Scotti L et al. A meta-analysis of alcohol drinking and oral and pharyngeal cancers. Part 1: Overall results and dose-risk relation. *Oral Oncology* 2010; 46(7):497-503.
14. Rota M, Bellocco R, Scotti L, Tramacere I, Jenab M, Corrao G et al. Random-effects meta-regression models for studying nonlinear dose response relationship, with an application to alcohol and esophageal squamous cell carcinoma. *Statistics in Medicine* 2010; 29(26):2679-87.
15. Fedirko V, Tramacere I, Bagnardi V, Rota M, Scotti L, Islami F et al. Alcohol drinking and colorectal cancer risk: an overall and dose-response meta-analysis of published studies. *Annals of Oncology* 2011; 22(9):1958-72.
16. Corrao G, Bagnardi V, Zambon A, La Vecchia C. A meta-analysis of alcohol consumption and the risk of 15 diseases. *Preventive Medicine* 2004; 38(5):613-19.
17. Islami F, Fedirko V, Tramacere I, Bagnardi V, Jenab M, Scotti L et al. Alcohol drinking and esophageal squamous cell carcinoma with focus on light-drinkers and never-smokers: a systematic review and meta-analysis. *International Journal of Cancer* 2011; 129(10):2473-84.

18. Key J, Hodgson S, Omar RZ, Jensen TK, Thompson SG, Boobis AR et al. Meta-analysis of studies of alcohol and breast cancer with consideration of the methodological issues. *Cancer Causes & Control* 2006; 17(6):759-70.
19. Samokhvalov AV, Irving H, Mohapatra S, Rehm J. Alcohol consumption, unprovoked seizures, and epilepsy: A systematic review and meta-analysis. *Epilepsia* 2010; 51(7):1177-84.
20. Taylor B, Irving HM, Baliunas D, Roerecke M, Patra J, Mohapatra S et al. Alcohol and hypertension: gender differences in dose-response relationships determined through systematic review and meta-analysis. *Addiction* 2009; 104(12):1981-90.
21. Kodama S, Saito K, Tanaka S, Horikawa C, Saito A, Heianza Y et al. Alcohol Consumption and Risk of Atrial Fibrillation A Meta-Analysis. *Journal of the American College of Cardiology* 2011; 57(4):427-36.
22. Patra J, Taylor B, Irving H, Roerecke M, Baliunas D, Mohapatra S et al. Alcohol consumption and the risk of morbidity and mortality for different stroke types - a systematic review and meta-analysis. *Bmc Public Health* 2010; 10.
23. Samokhvalov AV, Irving HM, Rehm J. Alcohol consumption as a risk factor for pneumonia: a systematic review and meta-analysis. *Epidemiology and Infection* 2010; 138(12):1789-1795.
24. Rehm J, Taylor B, Mohapatra S, Irving H, Baliunas D, Patra J et al. Alcohol as a risk factor for liver cirrhosis: A systematic review and meta-analysis. *Drug and Alcohol Review* 2010; 29(4):437-445.
25. Irving HM, Samokhvalov AV, Rehm J. Alcohol as a risk factor for pancreatitis. a systematic review and meta-analysis. *Journal of Pancreas* 2009; 10(4):387-392.
26. Taylor BJ, Shield KD, Rehm JT. Combining best evidence: a novel method to calculate the alcohol-attributable fraction and its variance for injury mortality. *BMC Public Health* 2011; 11:265.
27. Baliunas DO, Taylor BJ, Irving H, Roerecke M, Patra J, Mohapatra S et al. Alcohol as a Risk Factor for Type 2 Diabetes A systematic review and meta-analysis. *Diabetes Care* 2009; 32(11):2123-32.
28. Roerecke M, Rehm J. The cardioprotective association of average alcohol consumption and ischaemic heart disease: a systematic review and meta-analysis. *Addiction* 2012; 107(7):1246-60.
29. Gunning-Schepers L. The health benefits of prevention: a simulation approach. Health Policy (New York) [Internet]. 1989 Jul [cited 2013 Jul 15];12(1-2):1–255. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10303654.
30. Fillmore KM, Kerr WC, Stockwell T, Chikritzhs T, Bostrom A. Moderate alcohol use and reduced mortality risk: Systematic error in prospective studies. Addict Res Theory [Internet]. Informa UK Ltd UK; 2006 Jan 20 [cited 2014 Jun 3];14(2):101–32. Available from: http://informahealthcare.com/doi/abs/10.1080/16066350500497983.
31. Hill-McManus D, Angus C, Meng Y, Holmes J, Brennan A, Sylvia Meier P. Estimation of usual occasion-based individual drinking patterns using diary survey data. Drug Alcohol Depend [Internet]. 2013 [cited 2013 Dec 9]; Available from: http://www.sciencedirect.com/science/article /pii/S0376871613004018
32. Holmes J, Meier PS, Booth A, Guo Y, Brennan A. The temporal relationship between per capita alcohol consumption and harm: a systematic review of time lag specifications in aggregate time series analyses. Drug Alcohol Depend. 2012 Jun 1;123(1-3):7–14.
33. Jones L, Bellis M, Dedman D, Sumnall H, Tocque K. Alcohol-attributable fractions for England Alcohol-attributable mortality and hospital admissions. Liverpool: North West Public Health Observatory, Centre for Public Health Research Directorate, Liverpool John Mores University, Liverpool; 2008.
34. Cardiff Research Consortium. Health Outcomes Data Repository. 2011.
35. Revisions made to the multipliers and unit costs of crime used in the Integrated Offender Management Value for Money Toolkit [Internet]. [cited 2014 May 27]. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/118042/IOM-phase2-costs-multipliers.pdf
36. ONS. Labour Force Survey. 2013.
37. Roche, A. M., Pidd, K., Berry, J. G., & Harrison, J. E. 2008. Workers' drinking patterns: the impact on absenteeism in the Australian work-place. *Addiction*, vol. 103, no. 5, pp. 738-748.
38. HM Treasury. The green book: appraisal and evaluation in central government. London: The Stationary Office; 2003.
39. Meier**,** PS, Meng, Y, Holmes, J, Baumberg, B, Purshouse, R, Hill-McManus, D, Brennan, A. Adjusting for unrecorded consumption in survey and per capita sales data: Quantification of impact on gender- and age-specific alcohol-attributable fractions for oral and pharyngeal cancers in Great Britain. Alcohol Alcohol. 2013; doi: 10.1093/alcalc/agt001.