

Differential price responsiveness among drinker types

Working Paper

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Head Office: 71-75 Shelton Street, Covent Garden, London, WC2H 9JQ, United Kingdom.

w: www.londecon.co.uk e: info@londecon.co.uk

t: +44 (0)20 7866 8185 f: +44 (0)20 7866 8186

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Glossary

Terminology abbreviations

BRFSS	US Behavioural Risk Factor Surveillance System
CBA	Centre for Information on Beverage Alcohol
CEBR	Centre for Economics and Business Research
EFS	UK Expenditure and Food Survey
FMM	Finite Mixture Model
HRS	US Health and Retirement Survey
IFS	Institute For Fiscal Studies
NBER	National Bureau of Economic Research
NHIS	US National Health Interview Survey
NIAAA	US National Institute on Alcohol Abuse and Alcoholism
NLAES	US National Longitudinal Alcohol Epidemiologic Survey
NLSY97	US National Longitudinal Survey of Youth 1997
OLS	Ordinary Least Squares
PSID	US Panel Study of Income Dynamics
RePEc	Research Papers in Economics
RLMS	Russian Longitudinal Monitoring Survey
SSRN	Social Science Research Network



Executive summary

The objective of this review is to understand all the available evidence relating to whether behavioural responses to alcohol price changes vary across different types of drinkers. Specifically, the study aims to understand whether the price sensitivity of consumption of heavy drinkers differs from that of moderate drinkers and, if there is a difference, in what direction that is. We examine the evidence relating to two different types of price response:

- Firstly, the **'aggregate' (or 'overall') price response** refers to the change in the overall demand for alcohol in general (including all types of alcohol) in response to an increase in the overall price of alcohol. It is important to differentiate the aggregate price response from the 'own-price response' of a particular type of alcohol (e.g. how responsive the demand for beer is to a change in the price of beer). A large own-price response may not translate into a large aggregate price response, since the own-price response may be accompanied by substitution to other types of alcohol.
- Secondly, the **'cross-price' (or 'substitution') response** refers to the change in demand for a particular type of alcohol (such as wine) in response to a change in the price of another type of alcohol (such as beer).

Although some studies examine differences in own-price responsiveness across drinker types, this review excludes evidence that relates only to the 'own-price response' of drinkers. This is because our study aims to inform how overall consumption of alcohol among different types of drinkers will change as a result of a general increase in prices.

Price responsiveness of overall alcohol consumption

Overall, a clear majority of the relevant studies show that heavier drinkers are less responsive to price changes than moderate drinkers. We divide the evidence supporting this conclusion into two parts according to the type of research undertaken:

- 1) Empirical studies (including studies that undertake primary data analysis and meta-analysis studies); and
- 2) Literature reviews.

The most compelling evidence comes from studies that conduct primary data analysis, especially those that compare moderate and heavy drinkers directly using individual-level data. These studies find that, in terms of aggregate price responsiveness, heavier drinkers are less responsive to price changes than moderate drinkers. This conclusion is also supported by recent meta-analysis work.

Empirical studies

The most relevant studies analyse individual-level data in order to directly compare the price sensitivities of light and heavy drinkers. A number of studies undertake this type of analysis using large datasets from the United States or the United Kingdom, and the main studies show that the aggregate price responsiveness of heavy drinkers is less than that of moderate drinkers. In particular the following key studies are to be noted:

- Manning et al (1995) analyse data on individuals from the United States. They find that a drinker at the middle of the consumption distribution is highly responsive to price, whereas the heaviest drinkers are unresponsive.
- This is supported by Ayyagari et al (2009), who also analyse data on individuals from the United States. They identify two sub-groups within the population with very different drinking levels and sensitivity to prices: the light drinking group is responsive to price, whilst the heavy drinking group is unresponsive.
- A third study supporting the conclusion that heavy drinkers are less responsive to price changes than moderate drinkers has been undertaken by An and Sturm (2011). Again using US data, they find that tax effects are large among light drinkers but shrink substantially for moderate and heavy drinkers.
- Saffer et al (2012) demonstrate that among young adults in the United States moderate drinkers are more price sensitive than heavy drinkers.
- Meier et al (2008) analyse data on individuals in England. They find that, at the aggregate level, hazardous and harmful drinkers are less price sensitive than moderate drinkers. However, combining own-price and cross-price elasticity estimates calculated elsewhere in the same study (instead of their aggregate elasticity estimates), they also calculate that a 10% general price rise would reduce the alcohol consumption of heavy drinkers more than that of moderate drinkers. Hence there is some ambiguity about the correct interpretation of this study.
- Finally, a recent meta-analysis by Wagenaar et al (2008), which systematically combines evidence from several independent studies, shows that heavy drinking is less responsive to price changes than drinking in general.

It should be noted that all of the studies above were funded by public health agencies or organisations aiming to promote health and health care. Therefore, from a public policy perspective, their conclusions are highly credible as they are unlikely to be biased towards finding that heavy drinkers are less price sensitive.¹ In addition, three studies (Manning et al (1995), An and Sturm (2011), and Wagenaar (2008)) are published in peer-reviewed journals, and two of these (Manning et al (1995) and Wagenaar (2008)) have been cited on more than 200 occasions. Therefore, we consider the evidence showing that heavy drinkers are less responsive to price changes to be highly reliable.

- Supplementary evidence comes from studies which examine the impact of prices on the consequences of drinking or on measures of heavy drinking within the population.² However, since these studies do not directly compare different types of drinkers they only

¹ Manning et al (1995), Ayyagari et al (2009), An and Sturm (2011) and Saffer et al (2012) were funded by the US National Institute on Alcohol Abuse and Alcoholism (NIAAA), Meier et al was funded by the UK Department of Health, and Wagenaar et al (2009) was funded by the Robert Wood Johnson Foundation (which aims to improve health and health care in the United States).

² Such as Farrel et al (2003), Helakorpi et al (2010), Keng and Huffman (2010), and Stout et al (2000).

provide indirect evidence on the relative price sensitivities of moderate and heavy drinkers (and so are less relevant for the present study).

Literature reviews

Rather than formally combining the results from independent studies (as done in a meta-analysis), literature reviews gather and synthesise previous studies in order to make a more subjective overall assessment of the evidence.

Overall, literature reviews provide a mixed picture with respect to the relative price sensitivity of heavy and moderate drinkers even if often they consider the same studies.

Therefore it is hard to draw overall conclusions from these studies. Furthermore, past literature reviews often suffer from a number of limitations: many do not identify the specific type of price response concerned (i.e. aggregate or own-price), and often they do not take into account some of the most recent and relevant empirical research.

Because of the above-mentioned limitations of the literature reviews, they are much less informative on the differential effects of alcohol price increases on different types of drinkers and it is much more valuable to focus on the individual studies that focus directly on the issue of differential responses to price changes.

Overall conclusion

The studies that compare moderate and heavier drinkers directly using individual-level data and the comprehensive meta-analysis study mentioned above provide convincing evidence that, at the aggregate level, heavier drinkers are less responsive to prices changes than moderate drinkers.

This finding has important implications for policy makers. It implies that, if all alcohol prices were to increase by a similar percentage, the resulting overall reduction in alcohol consumption by heavy drinkers (also in percentage terms) is likely to be less than that of moderate drinkers.

1 Introduction

SABMiller commissioned London Economics to undertake this study to examine the evidence relating to differences in alcohol price responsiveness amongst different drinker types.

1.1 Objective

The objective of this review is to understand all the available evidence relating to whether behavioural responses to alcohol price changes vary across different types of drinkers. Specifically, the study aims to understand whether the price sensitivity of consumption of heavy drinkers differs from that of moderate drinkers, and if there is a difference, in what direction the relationship operates.

1.2 Approach

The approach to this research entailed reviewing articles and papers available from three literature repositories – the Centre for Information on Beverage Alcohol (CBA), the Social Science Research Network (SSRN), and the Research Papers in Economics databases (RePEc) – as well as material obtained from a more general internet search for publically available material.

Potentially relevant articles and papers were retrieved based on titles and abstracts, before a thorough review was undertaken in order to answer the key study questions. In total 148 papers were initially gathered and reviewed. Of these, this report is based on 23 key references that are precisely relevant to the main research questions.

1.3 Types of price response

This study examines the evidence relating to two different types of price response:

- Firstly, the **'aggregate' (or 'overall') price response** refers to the change in the overall demand for alcohol in general (including all types of alcohol) in response to an increase in the overall price of alcohol. It is important to differentiate the aggregate price response from the 'own-price response' of a particular type of alcohol (e.g. how responsive the demand for beer is to a change in the price of beer). A large own-price response may not translate into a large aggregate price response, since the own-price response may be accompanied by substitution to other types of alcohol.
- Secondly, the **'cross-price' (or 'substitution') response** refers to the change in demand for a particular type of alcohol (such as wine) in response to a change in the price of another type of alcohol (such as beer).

Chapter 2 covers the evidence relating to aggregate price responsiveness, whereas Chapter 3 covers the evidence relating to cross-price responsiveness.

Although some studies examine differences in own-price responsiveness across drinker types, this review excludes evidence that relates only to the 'own-price response' of drinkers³. This is because our study aims to inform how overall consumption of alcohol among different types of drinkers will change as a result of a general increase in prices.

In addition, there are a number of studies that focus exclusively on the price sensitivity of youths (i.e. high school students or under-21s).⁴ However, since extrapolating the findings of such studies to the general population may be misleading (as noted by Heeb et al, 2003), these studies are also not included in our review.

For each study included in the main body of evidence in this review and discussed below, Table 3 in Annex 1 presents information on the type of research undertaken, journal of publication, whether the study has been peer-reviewed, number of citations for each study, and the organisation(s) that funded the research.

³ For example French et al (2006), Kuo et al (2003) and Heeb et al (2003).

⁴ For example Laixuthai and Chaloupka (1993) analyse data on alcohol consumption by high school seniors in the United States, whereas Grossman et al (1987) and Coate and Grossman (1988) analyse consumption by 16 to 21 year-olds (also in the United States).

2 Price responsiveness of overall alcohol consumption

This chapter examines the evidence relating to the aggregate price responsiveness of different types of drinker. On balance, the evidence suggests that, at the aggregate level, heavier drinkers are less responsive to price changes. This overall conclusion is based on the evidence presented below, which we divide according to the type of research undertaken:

- 1) The first section considers empirical studies.
- 2) The second section considers relevant literature reviews.

The most compelling evidence comes from studies that conduct primary data analysis, especially those that compare moderate and heavier drinkers directly using individual-level data, and also from meta-analysis research.

2.1 Empirical studies

This section examines studies that undertake primary data analysis in order to assess whether price sensitivity differs according to an individual's level of alcohol consumption and meta-analysis studies that systematically combine empirical evidence from several independent sources. Overall, these studies suggest that, in terms of aggregate price responsiveness, heavy drinkers are less responsive to price changes than moderate drinkers.

Furthermore, the main studies were funded by health agencies, implying that they are unlikely to be biased towards finding that heavy drinkers are less price sensitive:

- According to Manning et al (1995), moderate drinkers respond to price changes whereas heavy drinkers are unresponsive. This study was funded by the National Institute on Alcohol Abuse and Alcoholism (NIAAA)⁵, is published in a peer-reviewed journal, and has been cited on more than 200 occasions (see Table 1 for information on peer-review, citations and funding).
- Ayyagari et al (2009) also find that moderate drinkers are price sensitive whereas heavy drinkers are not. This research was also funded by the NIAAA, and although it has fewer citations this is likely to be because it was published much more recently (it has not been peer-reviewed).
- An and Sturm (2011) show that alcohol taxes and prices affect consumption among light drinkers, but these effects shrink substantially for heavier drinkers. This is another study funded by the NIAAA, and is published in a peer-reviewed journal. Since it was published only last year, it has no citations at this stage.
- Meier et al (2008) find that, at the aggregate level, hazardous and harmful drinkers are less price sensitive than moderate drinkers. This research was funded by the UK

⁵ The mission statement of the NIAA is to provide "leadership in the national effort to reduce alcohol-related problems". The NIAAA is a federally funded organization and not a fund-raising organization, although the NIAA does accept donations and bequests to support its research mission.

Department for Health. Although the study itself was not peer-reviewed and has 13 citations, the results have appeared in subsequent papers by the same authors that are published in peer-reviewed journals and have received a greater number of citations⁶.

- Saffer et al (2012) demonstrate that among young adults moderate drinkers have more elastic demand than heavy drinkers. This study was funded by the NIAAA and currently has 1 citation (it has not been peer-reviewed).
- Finally, a meta-analysis from Wagenaar et al (2012) shows that heavy drinking is less responsive to price changes than moderate drinking. This paper was published in a peer-reviewed journal, has been cited 217 times, and was part funded by the Robert Wood Johnson Foundation (which aims to improve health and health care in the United States).

Each of these studies are summarised in more detail in section 2.1.1. Since several studies demonstrating that heavy drinkers are less responsive to price changes are published in peer reviewed journals, and two in particular have been cited very many times, these are judged to be especially reliable (see Table 1 for information on peer-review, citations and funding).

⁶ For example Meier, Purshouse and Brennan (2009) “Policy options for alcohol price regulation: the importance of modelling population heterogeneity”, which is published in *Addiction* and has 26 citations.

Table 1: Main evidence (empirical studies)

Study	Publication	Peer-review	Citations ¹	Funding
Manning et al. (1995)	Journal of Health Economics	Yes	235	National Institute on Alcohol Abuse and Alcoholism
Ayyagari et al (2009)	NBER working paper	No	7	National Institute on Alcohol Abuse and Alcoholism
An and Sturm (2011)	Journal of Mental Health Policy and Economics	Yes	0	National Institute on Alcohol Abuse and Alcoholism / National Institute of Environmental Health Sciences
Meier et al (2008)	Department of Health publication	No ²	13 ³	Department of Health Policy Research Programme
Saffer et al (2012)	NBER working paper	No	1	National Institute on Alcohol Abuse and Alcoholism
Wagenaar et al (2008)	Addiction	Yes	217	Part funded by the Robert Wood Johnson Foundation
Cook et al (2011)	BMC Public Health	Yes	1	Government Office North West as part of the Big Drink Debate
Ipsos (2009)	Brewers of Europe publication	No	0	Brewers of Europe
Herzfeld et al (2011)	Iowa State University working paper	No	0	N.A.
Farrel et al (2003)	Journal of Health Economics	Yes	51	National Institute on Alcohol Abuse and Alcoholism / UnitedHealth Group
Helakorpi et al (2010)	Alcohol and Alcoholism	Yes	7	N.A.
Keng and Huffman (2010)	Journal of Population Economics	Yes	15	Iowa Agriculture and Home Economics Experiment Station
Stout et al (200)	Journal of Studies on Alcohol	Yes	40	National Institute on Alcohol Abuse and Alcoholism

Note: 1. Number of citations is given by Google Scholar's "Cited by" count. 2. Although the original study was not peer reviewed, the results from this study have appeared in subsequent papers by the same authors, such as Meier, Purshouse and Brennan (2010a) "Policy options for alcohol price regulation: the importance of modelling population heterogeneity", which have been published in peer reviewed journals. 3. The results from this study have appeared in subsequent papers by the same authors, such as Meier, Purshouse and Brennan (2010a) "Policy options for alcohol price regulation: the importance of modelling population heterogeneity", which has 26 citations.

2.1.1 Empirical studies that compare the price sensitivities of light and heavy drinkers

The most relevant studies analyse individual-level data in order to directly compare the price sensitivities of light and heavy drinkers. A number of studies undertake this type of analysis using large datasets from the United States or the United Kingdom. In addition, a further study undertakes a meta-analysis using formal statistical techniques in order to combine the findings from several independent studies.

These studies show that the aggregate price responsiveness of heavy drinkers is less than that of moderate drinkers (see also Table 2 below):

- Manning et al (1995) analyse data on around 19,000 individuals from the United States in order to investigate whether the aggregate price responsiveness of alcohol demand varies according to drinking level. In order to differentiate between heavy and moderate drinkers they conduct quantile regressions, estimating models for eleven quantiles along the consumption level distribution (0.05, 0.1, 0.2, ... 0.8, 0.9 and 0.95). The analysis suggests

that price responsiveness follows a 'U-shaped' pattern across the drinking distribution: the median drinker has a statistically significant aggregate price elasticity of -1.19, whereas those at either end of the distribution (i.e. the (bottom) 5th percentile and the (top) 90th percentile) are much less responsive (with elasticities of -0.56 and -0.49 respectively). The price elasticity of the heaviest drinkers (the 95th percentile) is not statistically significant, meaning we cannot reject the hypothesis that these drinkers are not affected by price at all.

- This analysis is supported by Ayyagari et al (2009), who analyse (more recent) data on nearly 72,000 individuals from the United States in order to estimate the aggregate price responsiveness of drinkers. Using finite mixture models (FMM), they identify two sub-groups within the population with very different drinking levels and sensitivity to prices. The larger group (75% of the sample) drinks less (0.129 alcoholic drinks per day⁷) and is responsive to changes in the price of alcohol (with a coefficient on the price variable of -1.6, p-value < 0.001). Conversely, the smaller group (25% of the sample) drinks much more (1.879 alcoholic drinks per day) and is unresponsive to price (with an insignificant coefficient on the price variable equal to -0.035). In fact, like Manning et al (1995), the analysis could not identify any significant link between the price of alcohol and the alcohol consumption of this group.
- A third study which provides further support for the conclusion that heavier drinkers are less responsive to price changes than moderate drinkers was undertaken by An and Sturm (2011). They investigate differences in aggregate *tax* sensitivity across different drinker types using data on alcohol consumption for nearly 4 million individuals from the United States between 1984 and 2009. It is common for studies to use alcohol taxes as a 'proxy' for price, since changes in the two are strongly linked and taxation is a deliberate alcohol pricing policy⁸. The study categorises drinkers as 'light', 'moderate' or 'heavy' (defined as those who drink 1-40, 41-99 and 100+ drinks per month respectively). Their results indicate that tax effects "are relatively large and significant among light drinkers but shrink substantially for moderate and heavy drinkers". The elasticity for light drinkers is estimated to be -0.32 and is statistically significant. On the other hand, elasticity estimates for moderate and heavy drinkers are not statistically significant, so the idea that consumption by these drinkers is completely unresponsive to tax changes cannot be rejected⁹.
- Saffer et al (2012) also demonstrate that moderate drinkers have more elastic demand than heavy drinkers. This paper presents empirical work based on the National Longitudinal Survey of Youth 1997 (NLSY97) from 2002-2009, and includes both FMM and

⁷ The drinks per day measure includes any type of the alcohol drink (i.e. it does not differentiate between a glass of beer, a glass of wine etc). See Annex 1.

⁸ For example, Dave and Saffer (2007) estimate tax responsiveness and translate this into price responsiveness using the method set out by Kenkel (2005).

⁹ It should be noted that the definition of a 'light' drinker used here corresponds closely to the 'moderate' drinker definition used in other studies: Meier et al (2008) define 'moderate' drinkers as men drinking up to 21 units per week and women drinking up to 14 units per week, i.e. up to 17.5 units per week on average for both men and women; An and Sturm (2011) define 'light' drinkers as those consuming between 1 and 40 standard drinks per month, where standard drink is any drink containing 14g of pure alcohol, which is equivalent to just over 16 units per week. See Table 2 for definitions of drinkers types used across studies.

quantile regression results. Individuals in the sample are aged 18 to 29, with an average age of 24, so the results relate to relatively young adult drinkers. Non-drinkers are excluded from the calculations. The FMM results identify two groups within the population: the larger, moderate drinking group are price sensitive (elasticity of -0.49) whereas the smaller, heavy drinking group are not (elasticity is statistically insignificant).¹⁰ The quantile regression results provide price elasticities for nine quantiles among the alcohol consumption distribution: the elasticities show a general downward trend from the 10th quantile (i.e. light drinkers) to the 90th quantile (i.e. heavy drinkers) and are insignificant beyond the 60th quantile. Thus the study concludes that heavy drinkers are less responsive to price than moderate drinkers and higher excise taxes on alcohol reduce consumption by moderate drinkers but are of less importance in reducing heavy consumption.

- Meier et al (2008) analyse the price responsiveness of ‘moderate’, ‘hazardous’ and ‘harmful’ drinkers using alcohol pricing and purchasing data for almost 70,000 individuals in England. The study measures the aggregate price responsiveness of total alcohol purchasing for moderate drinkers and a combined hazardous and harmful drinkers group. The results “are in broad agreement with the literature, showing that – at the highest level of aggregation – hazardous and harmful drinkers (combined elasticity of -0.21) are less price elastic than moderate drinkers (elasticity of -0.47)”. However, combining own-price and cross-price elasticity estimates calculated elsewhere in the same study (instead of their aggregate elasticity estimates), they also calculate that a 10% general price rise would reduce the alcohol consumption of moderate drinkers by 3.5%, compared to 4.7% for hazardous drinkers and 4.5% for harmful drinkers.¹¹ Hence, the correct interpretation of the study is somewhat ambiguous¹². Although the finding that the hazardous and harmful drinkers group are, at the aggregate level, less price sensitive further bolsters the conclusion that price changes have a greater impact on moderate drinkers, this ambiguity means that less emphasis can be placed on the study¹³.
- Finally, Wagenaar et al (2009) show that, although prices and taxes do affect heavy drinking, heavy drinking is less responsive to price changes than moderate drinking. These findings are based on a meta-analysis of 112 studies, containing 1,003 estimates of the relationship between alcohol prices or taxes and alcohol consumption. The authors provide estimates of the aggregate price responsiveness of alcohol demand for consumers in general and, separately, for heavy drinking in particular. No specific definition for a

¹⁰ The moderate drinking group have a mean value of alcohol consumption of 8.1 drinks per month whereas the heavy drinking group have an average consumption of 40 drinks per month.

¹¹ A critique by the CEBR (2009) highlights the inconsistency between the two sets of results calculated by Meier et al (2008) with respect to the relative aggregate price sensitivities of heavy and moderate drinkers.

¹² As a result of this ambiguity, subsequent papers have made differing interpretations of the findings of Meier et al (2008). For example, Rabinovich et al (2009), Meier et al (2010), Room and Livingston (2010), Black et al (2010), IFS (2010) and An and Sturm (2011) interpret the Meier et al (2008) results as implying that moderate drinkers are overall more price-sensitive than heavy drinkers. Conversely, Cook et al (2011) write that the Meier et al (2008) results suggest that harmful drinkers are more sensitive to price.

¹³ It should also be noted that the Sheffield group have subsequently included a sensitivity analysis in the second version of their model, in which the combined hazardous and harmful drinker own-price/cross-price elasticity matrix is attenuated based on the assumption used by Chisholm et al (2004) that heavy drinkers are one third less responsive than moderate drinkers (see Purhouse et al, 2009). However, the revised elasticity matrix is not applied to the 10% general price increase policy simulation, only minimum price policy simulations.

heavy drinker is provided, since indicators of 'heavy drinking' vary across the studies included in the meta-analysis.¹⁴ Based on simple means across estimated elasticities, heavy drinking appears to be less responsive to price changes than alcohol consumption in general:

- The average response of overall alcohol consumption with respect to alcohol price or tax is equal to -0.51; whereas
- Based on the ten studies included in the analysis that focus on the affect of alcohol prices or taxes on various indicators of heavy drinking the mean responsiveness is -0.28.

In addition, the more sophisticated meta-analysis also indicates that heavy drinking is less responsive than alcohol consumption in general. The meta-analysis results show:

- A (one standard deviation) change in alcohol price or tax results in a -0.06 (standard deviation) change in overall alcohol consumption, or -0.03 (standard deviations) based only on estimates drawn from individual-level studies; whereas
- Based on the studies which focus on the effect of alcohol prices or taxes on heavy drinking, all of which are individual-level studies, the standardised response measure is only -0.01.

Based on these results Wagenaar et al (2009) conclude that prices and taxes do affect heavy drinking, but that the magnitude of the effect is smaller than the effect on overall drinking.¹⁵

Three further studies analyse individual-level data in order to directly compare the price sensitivities of light and heavy drinkers. However, these studies are of limited usefulness since two – Cook et al (2011) and Ipsos (2009) – use data from individuals on how they *would* react to price changes rather than observed changes in behaviour resulting from actual changes in price, whereas the third – Herzfeld et al (2011) – does not have an alcohol price variable but instead uses a regional price index.

For each of the studies described above, the approaches used to categorise drinkers in terms of their alcohol consumption level and the different types of drinkers for which aggregate price responsiveness is measured are presented in Table 2. This table also outlines the key findings of each study from the perspective of our review. For more technical details on the approaches used

¹⁴ For example, the relationship between the price of alcohol and 'heavy episodic drinking' estimated by Stout et al (2000) (see below) and the relationship between the price of alcohol and 'binge drinking' and 'heavy binge drinking' estimated by Keng and Huffman (2010) are included in the meta-analysis for heavy drinking.

¹⁵ There are a number of other meta-analysis studies examining the relationship between the price of alcohol and alcohol demand (a widely cited example is Gallet, 2007). However, here we are only concerned with those studies which distinguish between moderate and heavy drinking. Further, this section (like the previous section) only focuses on the evidence relating to the aggregate price response of alcohol demand, so meta-analyses which distinguish between drinker types but are only concerned with the own-price response for specific beverages are excluded. For this reason the studies by Fogarty (2004, 2006, 2008 and 2010) are not covered.

in the various studies (including variable definitions, data sources and modelling techniques) see Annex 1.

Table 2: Summary of empirical studies that compare the aggregate price response of different drinker types			
Study [Country]	Approach to drinker categorisation	Aggregate price response measured for	Key finding
Manning et al (1995) [United States]	Divide the drinking level distribution (in terms of average daily consumption of pure alcohol) into quantiles.	Drinkers at 11 quantiles: 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 0.95	Drinkers at the middle of the distribution are responsive to price, but the heaviest drinkers are unresponsive.
Ayyagari et al (2009) [United States]	Two groups (identified using FMM) characterised in terms of average number of alcoholic drinks per day.	Heavy drinking group: 0.129 drinks/day Light drinking group: 1.879 drinks/day	The light drinking group is responsive to price, whilst the heavy drinking group is unresponsive.
An and Sturm (2011) [United States]	Three groups characterised in terms of standard drinks per month (a standard drink is any drink containing 14g of pure alcohol).	Light drinkers: 1-40 drinks/month Moderate drinkers: 41-99 drinks/month Heavy drinkers: 100+ drinks/month	Tax/price effects are relatively large and significant among light drinkers, but shrink substantially for moderate and heavy drinkers.
Saffer et al (2012) [United States]	Two approaches: 1) Sample split into two groups (identified using FMM) characterised in terms of average number of drinks per day; 2) Divide the drinking level distribution into quantiles.	Heavy drinking group: 40 drinks/month Moderate drinking group: 8.1 drinks/month Drinkers at 9 quantiles: 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9	The moderate drinking group are price sensitive whereas the heavy drinking group are not. Aggregate elasticities show a general downward trend from the 10 th quantile to the 90 th quantile and are insignificant above the 60 th quantile.
Meier et al (2008) [UK]	Four groups characterised in terms of units of alcohol consumed per week (aggregate price response is only calculated for two of the four groups).	Moderate drinkers: 0-21 units/week for men; 0-14 units/week for women Hazardous & harmful drinkers: 22+ units/week for men; 15+ units/week for women ¹	At the aggregate level hazardous and harmful drinkers are less price sensitive than moderate drinkers.
Wagenaar et al (2008) [various countries]	Meta-analysis of studies that measure the price elasticity of drinking in general and, separately, studies that measure the price elasticity of heavy drinking.	'Heavy drinking' and overall drinking. No specific definition of a heavy drinker is provided since indicators of 'heavy drinking' vary across the studies included in this.	Heavy drinking is less responsive than alcohol consumption in general.

Table 2: Summary of empirical studies that compare the aggregate price response of different drinker types

Study [Country]	Approach to drinker categorisation	Aggregate price response measured for	Key finding
Cook et al (2011) [UK]	Four groups characterised in terms of grams of pure alcohol per day, further broken-down according to income (three categories).	Light drinkers: 1-20 grams/day Low-medium drinkers: 21-40 grams/day High-medium drinkers: 41-60 grams/day Heavy drinkers: 61+ grams/day (by low/medium/high income)	Heavier drinkers are least likely to believe that low prices increase consumption. However regression analysis suggests drinking level only influences price sensitivity in combination with income.
Ipsos (2009) [Denmark, Portugal, Germany, Czech Republic]	Three groups characterised in terms of drinking occasions per week, plus three groups characterised in terms of number of drinks on a typical occasion.	Regular drinkers: 4+ times/week Occasional drinkers: 1-3 times/week Infrequent drinkers: 3 times/month or less Irresponsible drinkers: 5+ drinks/occasion Moderate drinkers: 2-4 drinks/occasion Light drinkers: 1 drink/occasion	Those who regularly or occasionally drink irresponsibly are less likely than other consumers to reduce their alcohol consumption in response to price increases (although the study has a major weakness since only selected figures are reported making it impossible to observe the full picture from the data).
Herzfeld et al (2011) [Russia]	Two groups characterised in terms of being above or below the median level of alcohol consumption (in grams of alcohol per day) in the first year of the panel (1994).	Light drinkers: below median Heavy drinkers: above median (median = 62 grams of alcohol per day)	Both high and low consumption groups do not respond to price, in contrast to findings from the USA and Europe, where drinkers (especially moderate drinkers) are found to be price sensitive.

Note: 1. The *hazardous & harmful* drinkers group is a combined group including both *hazardous* drinkers (22-50 units/week for men, 15-35 units/week for women) and *harmful* drinkers (51+ units/week for men, 36+ units/week for women).

2.1.2 Empirical studies that examine the impact of prices on the consequences of heavy drinking or on measures of heavy drinking within the population

Supplementary evidence comes from studies that examine the impact of prices on the consequences of heavy drinking or on measures of heavy drinking within the population. Since these studies do not directly compare different types of drinkers, they only provide indirect evidence on the relative price sensitivities of moderate and heavy drinkers, and so are less relevant for the present study. Such studies are more useful for our purposes when systematically combined with evidence relating to the impact of prices on drinking in general, as done by Wagenaar et al (2009) in their meta-analysis study (discussed in the previous sub-section). Four examples are:

- Farrel et al (2003) estimate the impact of the overall price of alcohol on four ‘dimensions’ of alcohol dependence and abuse: ‘heavier drinking’, ‘physical and other consequences of drinking’, ‘increased salience of drinking’, and ‘alcohol dependence/abuse’. Their analysis is based on data from interviews with around 43,000 individuals in the United States in 1991 and 1992.¹⁶ They find that the likelihood that an individual suffers, at least to some extent, from one of these dimensions of alcohol dependence/abuse is significantly affected by the price of alcohol, although the severity of their condition is not affected by price.
- Helakorpi et al (2010) examine the prevalence of ‘moderate to heavy drinking’ and ‘heavy episodic drinking’ in Finland before and after taxes on alcohol were reduced by a third (on average) in March 2004¹⁷. Following the reduction in prices, increases in *heavy episodic drinking* were confined to men aged 45 or over; men with the lowest educational attainment; and women in the middle and upper educational groups. Since the cut-off point for the *moderate to heavy drinking* measure is well inside the ‘moderate’ category used in other studies¹⁸ this measure provides no information on the impact of the price reduction on heavy drinking.
- Keng and Huffman (2010) analyse the relationship between the price of alcohol and ‘binge drinking’ among individuals under the age of 40¹⁹. Their econometric results show that the overall price of alcohol has a statically significant impact on the binge drinking variables, so the authors conclude that an individual’s decision to binge drink is quite price-responsive.
- Stout et al (2000) examine the impact of the overall price of alcohol on the decision of a current drinker to drink heavily, and on the decision of a current drinker to engage in drinking and driving, using data on individuals from the USA from 1984 to 1995. The results show that the average alcohol price has no statically significant effect on the probability that a current drinker engages in heavy episodic drinking or drink driving.

2.2 Literature reviews

This section covers recent literature reviews which examine the response of overall alcohol demand to price changes with at least a partial focus on the differing responses of heavy and light drinkers. Rather than formally combining the results from independent studies (as done in a meta-analysis), literature reviews gather and synthesise previous studies in order to make a more subjective overall assessment of the evidence.

¹⁶ Around 5,000 individuals were lost to the analysis due to missing data.

¹⁷ For men (women) ‘moderate to heavy drinking’ is defined as having 8 (5) drinks per week, and ‘heavy episodic drinking’ is defined as having 6 or more drinks on a single occasion once a week (month). Since the cut-off point for their ‘moderate to heavy drinking’ measure is well inside the ‘moderate’ category used in other studies (e.g. Meier et al, 2008) this measure provides no information on the impact of the price reduction on heavy drinking.

¹⁸ Such as Meier et al (2008).

¹⁹ ‘Binge drinkers’ are defines as those who consume six or more drinks in one session on one to three occasions per month, and ‘heavy binge drinkers’ as those who consume six or more drinks in one session on four or more occasions per month.

Overall, literature reviews provide a mixed picture with respect to the relative price sensitivity of heavy and moderate drinkers. Some studies reach the conclusion that the evidence suggests that heavy drinkers are at least as responsive to price changes as drinkers in general, for example:

- According to Hunt et al (2011), who made an assessment of the impact of alcohol pricing policy options in the UK on behalf of the Home Office, different types of consumers vary in terms of the extent to which they respond to changes in alcohol prices. While they acknowledge that some studies have shown that heavy drinkers are relatively insensitive to price changes²⁰, they state that this “is not consistent with the balance of research”. In support of this, they reference two further literature reviews²¹ and one empirical study²². However, unfortunately some major empirical studies from the United States and United Kingdom that directly compare the price responsiveness of consumers with different consumption levels are omitted from their review²³. In addition, although the study by Wagenaar et al (2009) is cited, the authors do not mention their finding that the magnitude of the effect of prices and taxes on heavy drinking is smaller than the effects on overall drinking.
- A recent Home Office (2011) report finds that studies suggest that heavy drinkers may be more affected by price increases than moderate or occasional drinkers. However, this is mainly based on the evidence from the two other studies discussed here (namely Hunt et al, 2011, and Booth et al, 2008).

Conversely, other literature reviews conclude that heavy drinkers are less responsive to price changes than moderate drinkers:

- Focussing mainly on the findings from published meta-analyses (rather than reviewing individual studies), Xu and Chaloupka (2011) conclude that although the findings about the relative price sensitivity of abusive and non-abusive drinkers are mixed, the majority of studies find that heavy/frequent drinkers are generally less responsive to price changes than light/infrequent drinkers²⁴.
- According to Rabinovich et al (2009), who examine the link between alcohol affordability and consumption for EC DG SANCO, the effect of price changes on consumption appears to be smaller for heavy drinkers than for more moderate drinkers.²⁵

However, most literature reviews do not reach any explicit conclusion regarding whether heavy drinkers are more or less responsive to price changes than moderate drinkers:

²⁰ Citing a paper by Pacula and Chaloupka (2001) which in turn cites Manning et al (1995).

²¹ Namely Cook and Moore (2002) and Elder et al (2010), both discussed below.

²² Namely Farrel et al (2003), discussed above.

²³ Namely Manning et al (1995), Meier et al (2008) Ayyagari et al (2009) and An and Sturm (2011)

²⁴ Citing Wagenaar et al (2009) in support of this conclusion.

²⁵ In support of this conclusion they cite Wagenaar et al (2008) and the work by researchers at the University of Sheffield Meier et al (2008).

- According to Booth et al (2008), some studies have found that heavy drinkers may be more affected by increased prices than moderate or occasional drinkers. However, the examples they cite²⁶ relate only to heavy drinking among young drinkers (i.e. under 21), and not the population in general. They also cite an old study²⁷ that found that higher alcohol taxes reduce death rates from liver-cirrhosis more than they reduce consumption in general. Conversely, the authors cite one study²⁸ that finds that heavy drinkers are the least responsive to price, and a meta-analysis²⁹ that finds that although prices and taxes affect heavy drinking, the scale is smaller than the affect on drinking in general. The Manning et al (1995) study is omitted from the section of Booth et al (2008) that addresses the impact of price changes on heavy drinkers, despite the fact that Manning et al directly examine the price responsiveness of drinkers with different consumption levels.³⁰
- Elder et al (2010) find that most studies included in their review indicate that higher taxes or prices are associated with reductions in alcohol consumption in general and excessive alcohol consumption in particular, and that these effects may be more pronounced among groups with a higher prevalence of excessive alcohol consumption (for example young men). However, the authors also state that the available data are “not adequate to assess potential differences in price elasticities based on drinking pattern (i.e. between excessive and non-excessive drinkers)”.
- Chaloupka et al (2002) and Cook and Moore (2002) highlight evidence³¹ showing that higher alcohol taxes significantly reduce death rates from liver-cirrhosis, a key adverse outcome of heavy drinking, thus indicating that heavy alcohol consumption is responsive to price. However, Chaloupka et al (2002) also acknowledge two studies³², which find that a subset of heavy drinkers, namely the upper 5 percent, may be unresponsive to price.
- Finally, according to Heeb et al (2003), the empirical evidence concerning the relative price responsiveness of moderate and heavy drinkers is inconclusive. They cite old studies from the United States³³ and Scotland³⁴, which suggest that heavy drinkers are at least as responsive to price changes as moderate drinkers. They also note that this is supported indirectly by evidence from studies that demonstrates a relationship between alcohol prices and liver-cirrhosis.³⁵ However, they further point out that the studies from the United States³⁶ are based on young people only (aged 16 to 21), and therefore

²⁶ Laixuthai and Chaloupka (1993) and Coate and Grossman (1988).

²⁷ Cook and Tauchen (1982).

²⁸ Mast et al (1999).

²⁹ Wagenaar et al (2009).

³⁰ It should be noted that since Booth et al (2008) was published first this review could not take account to more recent empirical studies, such as Meier et al (2009), Ayyagari et al (2009) and An and Sturm (2011).

³¹ Grossman (1993) and Cook and Tauchen (1982).

³² Manning et al (1995) and Kenkell (1996).

³³ Grossman et al (1987) and Coate and Grossman (1988).

³⁴ Kendell, de Roumanie and Britson (1983)

³⁵ Citing Sloan et al (1994).

³⁶ i.e. Grossman et al (1987) and Coate and Grossman (1988).

extrapolation to the general population may be misleading. Conversely, Heeb et al (2003) cite Manning et al (1995) as a study that finds that heavy drinkers may be less price responsive than moderate drinkers.³⁷

Therefore, given these mixed conclusions and also the fact that there is significant overlap and cross-referencing between the studies, it is hard to draw an overall conclusion from the literature review evidence regarding whether or not heavy drinkers are less responsive to prices than moderate drinkers.

In addition, a common shortcoming of the literature reviews assessed is that many do not identify the specific type of price response examined in the original studies. In particular, they often do not differentiate between evidence relating to the aggregate price response of alcohol demand in general, and evidence relating to the own-price response of particular beverages.

2.3 Conclusions regarding price responsiveness of overall alcohol consumption

The most compelling evidence reviewed comes from studies which use individual-level datasets to directly compare the aggregate price responsiveness of lighter drinkers with that of heavier drinkers. These studies suggest that heavier drinkers are less responsive to price changes than moderate drinkers³⁸.

Supplementary evidence has been derived from studies that assess the impact of prices on the consequences of drinking or on measures of heavy drinking within the population.³⁹ Although these studies generally suggest that heavy drinking is responsive to the price of alcohol, they do not directly address whether heavy drinkers are more or less responsive to price changes than moderate drinkers.

Such studies are more useful for our purposes when systematically combined with evidence relating to the impact of prices on drinking in general. One meta-analysis study does so, and finds that prices and taxes do affect heavy drinking, but that the magnitude of the effect is smaller than the effect on overall drinking⁴⁰.

Taking studies that compare moderate and heavier drinkers directly using individual-level data with this comprehensive meta-analysis study, provides convincing evidence that, at the aggregate level, heavier drinkers are less responsive to prices changes than moderate drinkers.

This finding has important implications for policy makers. It implies that if all alcohol prices were to increase by a similar percentage, the resulting overall reduction in alcohol consumption by heavy drinkers (also in percentage terms) is likely to be less than that of moderate drinkers.

³⁷ It should be noted that since Heeb et al (2003) was published first this review could not take account to more recent empirical studies, such as Meier et al (2009), Ayyagari et al (2009) and An and Sturm (2011).

³⁸ Manning et al (1995), Ayyagari et al (2009), An and Sturm (2011), Meier et al (2008) and Saffer et al (2012).

³⁹ Such as Farrel et al (2003), Helakorpi et al (2010), Keng and Huffman (2010) and Stout et al (2000).

⁴⁰ Wagenarr et al (2009).

3 Responsiveness in terms of substitution between alcohol products

This section reviews some studies that examine the impact of price changes on substitution behaviour between alcohol products, distinguishing between the behaviour of moderate and heavy drinkers.

Three such studies, outlined below, produce mixed findings. The most comprehensive study, by Meier et al (2008), uses a large dataset on individuals from the UK in order to estimate cross-price elasticities of demand for beer, wine, spirits, and 'ready-to-drinks'. They find that hazardous drinkers show the greatest level of substitution behaviour: switching by hazardous drinkers "is an order of magnitude greater than that estimated for moderate drinkers" for some beverage types.

From a policy perspective, this implies that targeting the price of a particular beverage type (e.g. beer or cider) is unlikely to significantly reduce the overall alcohol intake of heavier drinkers, since these drinkers would be likely to simply switch to an alternative beverage type.

- Meier et al (2008) estimate own-price and cross-price elasticities of demand for 16 categories of alcoholic beverage⁴¹ separately for moderate, hazardous and harmful drinkers. These estimates are based on data from the Expenditure and Food Survey (EFS) between 2001 and 2005, which provides individual-level data on the volume of alcohol purchased and the price paid in the previous two-weeks, as well as information on the purchaser's characteristics. The authors have records for nearly 70,000 individuals. The authors estimate a system of 17 simultaneous equations, relating each individual's volume of consumption of each beverage type, in terms of units of equivalent alcohol, to the price of that beverage, the prices of each other beverage type, and the average price of other non-durable goods⁴². The system of equations is estimated using 'iterative three-stage least squares' models. Since the decomposition includes 16 different categories of alcoholic beverage, 240 cross-price elasticities are estimated for each drinker type⁴³. For all drinker types, the majority of the cross-price elasticities are of a substitute nature (199 out of 240 for moderate drinkers, 188 out of 240 for hazardous drinkers, and 169 out of 240 for harmful drinkers). This means that price changes result in switching between specific beverage types. The findings show that hazardous drinkers show the greatest level of substitution behaviour: hazardous drinkers show the highest degree of substitution behaviour for 103 of the 240 cross-price effects, relative to 52 out of 240 for moderate drinkers and 85 out of 240 for harmful drinkers. The authors note that in some cases switching by hazardous drinkers "is an order of magnitude greater than that estimated for moderate drinkers".
- Heeb et al (2003) examine the impact of a reduction in the price of spirits in Switzerland on beverage specific consumption of alcohol (for spirits, wine and beer), which occurred in July 1999 following a tax reform implemented based on a WTO agreement. The authors

⁴¹ The categories are: beers, wine, spirits, and 'ready-to-drinks', split by on- or off-trade, and split by low-priced and high-priced.

⁴² See Appendix 4 of Meier et al for more details.

⁴³ Plus 16 own-price elasticities.

have longitudinal data on changes in alcohol consumption in the Swiss population aged 15 years or over, collected at baseline 3 months before the price reduction and at a follow-up point 3 months after the price reduction. The sample size for analysis is 1,347 (all current drinkers at both baseline and follow-up). They categorise respondents as 'high-volume drinking' and/or 'binge drinking' at baseline and at follow-up.⁴⁴ Therefore, they create 4 drinking pattern subgroups:

- Stable high-volume drinkers (stable binge drinkers): high-volume drinkers (binge drinkers) at both baseline and follow-up
- Increased high-volume drinkers (increased binge drinkers): high-volume drinkers (binge drinkers) at follow-up only
- Stable low-volume drinkers (stable non-binge drinkers): low-volume drinkers (non-binge drinkers) at both baseline and follow-up
- Decreased high-volume drinkers (decreased binge-drinkers): high-volume drinker (binge drinker) at baseline only

They find no support for substitution effects, irrespective of the drinking pattern of the respondent⁴⁵. Rather, the results indicate an additive relationship between spirits and other types of alcoholic beverage. These results are at odds with those of Meier et al (2008), who found important substitution effects from changes in the price of spirits. It should be noted, however, that the analysis from Heeb et al (2003) is based on the effect of a price increase only. Further, Heeb et al (2003) does not provide any evidence relating to substitution effects due to changes in the prices of other beverage types.

⁴⁴ 'High-volume drinking' is defined as consuming 40g of pure per day for men and 20g of pure alcohol per day for women. 'Binge drinking' is defined as having had 6 or more drinks on a single occasion for men and 4 or more drinks on single a occasion for women, at least once during the month preceding interview. The 'high-volume drinking' thresholds fall within the 'hazardous' drinker category based on the Meier et al (2008) definition.

⁴⁵ In order to assess substitution effects, Heeb et al (2003) test changes in consumption of non-spirits in the total sample and in subgroups, including the drinking pattern subgroups outlined above. Cross-price elasticity of non-spirits is calculated by dividing the percentage changes in the consumption of non-spirits by percentage changes in the prices of spirits. The cross-price elasticity resulting from the 30-50% decrease in the price of spirits ranged from 0.06 to 0.1. Full results by subgroup are not presented

4 Overall conclusions of the literature review

As already noted above, the main studies using individual-level data and focusing on potentially different price sensitivities of moderate and heavier drinkers show that, at the aggregate level, heavier drinkers are less responsive to price changes than moderate drinkers. The key meta-analysis mentioned above comes to the same conclusion.

The evidence regarding the impact of price changes on substitution between alcohol products by moderate and heavy drinkers is more mixed. However, the most comprehensive study by Meier et al (2008) finds that hazardous drinkers show the greatest level of substitution behaviour: switching by hazardous drinkers “is an order of magnitude greater than that estimated for moderate drinkers” for some beverage types.

These general findings of the literature review have two important policy implications:

- First, if all alcohol prices were to increase by a similar percentage, the resulting overall reduction in alcohol consumption by heavy drinkers (also in percentage terms) is likely to be less than that of moderate drinkers.
- Second, targeting the price of a particular beverage type (e.g. beer or cider) is unlikely to significantly reduce the overall alcohol consumption of heavier drinkers, since these drinkers would be likely to simply switch to an alternative beverage type.

References

- An, R., and Sturm, R. (2011) *“Does the Response to Alcohol Taxes Differ Across Racial/Ethnic Groups? Some Evidence from 1984-2009 Behavioural Risk Factor Surveillance System”*, Journal of Mental Health Policy and Economics 14, 13-23.
- Anderson, K. (2010) *“Reforming Taxes on Wine and Other Alcoholic Beverage Consumption”*, Economic Papers, Volume 29, Issue 2, pages 197–199.
- Arnoult, M. and Tiffin, R. (2010) *“Minimum pricing of alcohol and its impact on consumption in the UK”*, paper presented at the 84th Annual Conference of the Agricultural Economics Society, 29-31 March 2010, Pollocks Hall, Edinburgh.
- Ayyagari, P., Deb, P., Fletcher, J., Gallo, W.T. and Sindelar, J.L. (2009) *“Sin Taxes: Do Heterogeneous Responses Undercut Their Value?”*, NBER Working Paper No. 15124.
- Babor, T.F., Caetano, R., Casswell, S., Edwards, G., Giesbrecht, N., Graham, K., Grube, J., Gruenewald, P., Hill, L., Holder, H., Homel, R., Osterberg, E., Rehm, J., Room, R. and Rossow, I. (2003) *“Alcohol: No Ordinary Commodity – Research and Public Policy”*, Oxford and London: Oxford University Press.
- Black, H., Gill, J. and Chick, J. (2010) *“The price of a drink: levels of consumption and price paid per unit of alcohol by Edinburgh’s ill drinkers with a comparison to wider alcohol sales in Scotland”*, Addiction, Volume 106, Issue 4, pages 729–736.
- Booth, A., Meier, P., Stockwell, T., Sutton, A., Wilkinson, A., Wong, R., Brennan A., O’Reilly, D., Purshouse, R. and Taylor, K. (2008) *“Independent Review of the Effects of Alcohol Pricing and Promotion: Part A. Systematic reviews”*, Department of Economics, Sheffield University.
- CEBR (2009) *“Minimum Alcohol Pricing: A targeted measure?”*, a report for SABMiller.
- CEBR (2010) *“Minimum Alcohol Pricing: A targeted measure?”*, a report to the Scottish Parliamentary Health and Sport Committee
- Chaloupka, F.J. (1993) *“The effects of price on alcohol-related problems”*, Alcohol Health and Research World, Volume 17, Number 1, pages 46-53.
- Chaplouka, F.J. (2009) *“Commentary: Alcoholic Beverage Taxes, Prices and Drinking”*, Addiction, Volume 104, Issue 2, pages 191–192.
- Chaloupka, F.J., Grossman, M. and Saffer, H. (2002) *“The Effects of Price on Alcohol Consumption and Alcohol-Related Problems”*, Alcohol Research and health, Volume 26, Number 1.
- Chisholm, D., Rehm, J., Van Ommeren, M. and Monteiro, M. (2004) *“Reducing the Global Burden of Hazardous Alcohol Use: A Comparative Cost-Effectiveness Analysis”*, Journal of Studies on Alcohol, Volume 65, Issue 6, pages 782-93.
- Coate, D. and Grossman, M. (1988) *“Effects of alcoholic beverage prices and legal drinking ages on youth alcohol use”*, Journal of Law and Economics 31(1), pages 145-171.

- Cook, P.J. and Moore, M.J. (2002) *"The Economics of Alcohol Abuse and Alcohol-Control Policies"*, Drugs, Economics & Policy, Volume 21, Number 2, pages 120-133.
- Cook, P., Phillips-Howard, P.A., Morleo, M., Harkins, C., Briant, L. and Bellis, M. (2011) *"The Big Drink Debate: Perceptions of the Impact of Price on Alcohol Consumption from a Large Scale Cross-Sectional Convenience Survey in North West England"*, BMC Public health, 11:664.
- Cook P. J. and Tauchen, G., (1982). *"The Effect of Liquor Taxes on Heavy Drinking"*, Bell Journal of Economics, Volume 13, Number 2, pages 379-390.
- Dave, D. and Saffer, H. (2003) *"Alcohol Advertising and Alcohol Consumption by Adolescents"*, NEBR Working Paper No. 9676.
- Dave, D. and Saffer, H. (2007) *"Risk Tolerance and Alcohol Demand among Adults and Older Adults"*, NBER Working Paper No. 13482.
- Dave, D. and Saffer, H. (2008) *"Alcohol demand and risk preference"*, Journal of Economic Psychology, Volume 29, Issue 6, pages 810–831.
- Doran, C.M and Digiusto, E. (2011) *"Using taxes to curb drinking: A report card on the Australian government's alcopops tax"*, Drug and Alcohol Review, Volume 30, Issue 6, pages 677–680.
- Elder, R.W., Lawrence, B., Ferguson, A., Naimi, T.S., Brewer, R.D., Chattopadhyay, S.K., Toomey, T.L. and Fielding, J.E. (2010) *"The Effectiveness of Tax Policy Interventions for Reducing Excessive Alcohol Consumption and Related Harms"*, American Journal of Preventive Medicine, Volume 38, Issue 2, pages 217–229.
- Farrell, S., Manning, W.G. and Finch, M.D. (2003) *"Alcohol Dependence and the Price of Alcoholic Beverages"*, Journal of Health Economics 22 (2003), pages 117-147.
- Fleenor, P. (2004) *"A Critique of the National Research Council and Institute of Medicine's Recommendation to Raise Alcohol Excises to Curb Underage Drinking"*, Tax Foundation Background Paper Number 43.
- Fogarty, J. (2004) *"The Own-Price Elasticity of Alcohol: A Meta-Analysis"*, University of Western Australia Economics Programme.
- Fogarty, J. (2006) *"The nature of the demand for alcohol: understanding elasticity"*, British Food Journal, Volume 108, Issue 4, pages 316 – 332.
- Fogarty, J. (2008) *"The Economics of Wine: Pricing, Quality and Rate of Return Part II: The Own-Price Elasticity of Demand for Alcohol"*, University of Western Australia, Discussion Paper 08.06
- Fogarty, J. (2010) *"The Demand for Beer, Wine and Spirits: A Survey of the Literature"*, Journal of Economic Surveys, Volume 24, Issue 3, pages 428–478.
- French, M.T., Brown-Taylor, D. and Bluthenthal, R.N. (2006) *"Price Elasticity of Demand for Malt Liquor Beer: Findings from a US Pilot Study"*, Social Science and Medicine, Volume 62, Number 9, pages 2101-2111
- Gallet, C.A. (2007) *"The demand for alcohol: a meta-analysis of elasticities"*, Australian Journal of Agricultural and Resource Economics Volume 51, Issue 2, pages 121–135.

- Grossman, M. (1993) *"The Economic Analysis of Addictive Behaviour"*, in Hilton, M.E. and Bloss G., eds. *Economics and the Prevention of Alcohol-Related Problems*.
- Grossman, M., Coate, D. and Arluck, G.M. (1987) *"Price Sensitivity of Alcoholic Beverages in the United States: Youth Alcohol Consumption"*, in Holder, H., ed. *Advances Abuse Prevention: Strategies for States and Communities*. Greenwich, CT: JAI.
- Heeb, J.L., Gmel, G., Zurbrügg, C., Kuo, M. and Rehm, J. (2003) *"Changes in alcohol consumption following a reduction in the price of spirits: a natural experiment in Switzerland"*, *Addiction*, Volume 98, Issue 10, pages 1433–1446.
- Helakorpi, S., Mäkelä, P. and Uutela, A., (2010) *"Alcohol consumption before and after a Significant reduction of Alcohol prices in 2004 in Finland: Were the Effects Different across Population Subgroups"*, *Alcohol and Alcoholism*, Volume 45, Issue 3, 286-292.
- Herzfeld, T., Huffman, S. K. and Rizov, M. (2011) *"The Dynamics of the Russian Lifestyle During Transition: Changes in Food, Alcohol and Cigarette Consumption"*, Iowa State University Department of Economics Working Paper No. 09019
- Home Office (2011) *"The likely impacts of increasing alcohol price: a summary review of the evidence base"*, Home Office publication.
- Hunt, P. Rabinovich, L. and Baumberg, B. (2011) *"Preliminary assessment of economic impacts of alcohol pricing policy options in the UK"*, RAND Corporation report.
- IFS (2010) *"The Importance of Introducing a Minimum Price on Alcohol in Britain"*, IFS Briefing Note 109.
- Ipsos (2009) *"Alcohol Price and Consumer Behaviour: Main results"*, Ipsos report for the Brewers of Europe, Réf. 09-004338-01.
- John, R.M. (2005) *"Price Elasticity Estimates for Tobacco and Other Addictive Goods in India"*, IGIDR Working Paper Series Number WP-2005-003.
- Kendell, R.E., De Roumanie, M. and Britson, E.B. (1983) *"Influence of an Increase in Excise Duty on Alcohol Consumption"*, *British Medical Journal*, 287, pages 809-811.
- Keng, S and Huffman, W.E. (2010) *"Binge drinking and Labour Market Success: A longitudinal Study on Young People"*, *Journal of Population Economics* 23: 303-322.
- Kenkel, D.S. (1996) *"New Estimates of the Optimal Tax on Alcohol"*, *Economic Inquiry*, Volume 34, Number 2, pages 296-319.
- Kenkel, D.S. (2005) *"Are alcohol tax hikes fully passed through to prices: Evidence from Alaska."* *American Economic Review*, 5(2):273-277.
- Katikireddi, V., Bonell, C. and Macintyre, S. (2011) *"How evidence based is English public health policy?"*, *British Medical Journal*.

- Kuo, M., Heeb, J.L., Gmel, G. and Rehm, J. (2003) *“Does Price Matter? The Effect of Decreased Price on Spirits Consumption in Switzerland”*, *Alcoholism: Clinical and Experimental Research*, Volume 27, Number 4, pages 720-725.
- Laixuthai, A. and Chaloupka, F.J. (1993), *“Youth alcohol use and public policy”*, *Contemporary Policy Issues*, Volume 11, pages 70-81.
- Manning, W.G., Blumberg, L. and Moulton, L.H. (1995) *“The demand for alcohol: The differential response to price”*, *Journal of Health Economics* 14(2):123–148.
- Mast, B.D., Benson, B. L. and Rasmussen, D.W. (1999) *“Beer taxation and alcohol-related traffic fatalities”*, *Southern Economic Journal*, Volume 66, Number 2, pages 214-249.
- Meier, P.S. (2010) *“Polarised Drinking Patterns and Alcohol Deregulation”*, *Nordic Studies on Alcohol and Drugs*, Volume 27, pages 383–408.
- Meier, P., Booth, A., O’Reilly, D., Stockwell, T., Sutton, A., Wilkinson, A., Wong, R., Brennan A., Purshouse, R., Taylor, K. and Rafia, R. (2008) *“Independent Review of the Effects of Alcohol Pricing and Promotion: Part B. Modelling the Potential Impact of Pricing and Promotion Policies for Alcohol in England: Results from the Sheffield Alcohol Policy Model Version 2008(1-1)”*, Department of Economics, Sheffield University.
- Meier, P.S., Purshouse, R. and Brennan, A. (2010a) *“Policy options for alcohol price regulation: the importance of modelling population heterogeneity”*, *Addiction*, Volume 105, Issue 3, pages 383-393.
- Meier, P.C., Purshouse, R. and Brennan, A. (2010b) *“Policy options for alcohol price regulation: response to the commentaries”*, *Addiction*, 105, pages 394–401.
- Moore, S.C. (2010) *“Substitution and Complementarity in the Face of Alcohol-Specific Policy Interventions”*, *Alcohol and Alcoholism*, Volume 45, Issue 5, pages 403–408.
- Rabinovich, L., Brutscher, P.B., De Vries, H., Tiessen, J., Clift, J. and Reding, A. (2009) *“The affordability of alcoholic beverages in the European Union Understanding the link between alcohol affordability, consumption and harms”*, RAND Europe report for the European Commission DG SANCO.
- Room, R. and Livingston, M. (2010) *“Commentaries on Meier et al. (2010)”*, *Addiction*, Volume 105, Issue 3, pages 394-401.
- Pacula, R. and Chaloupka, F.J. (2001) *“The Effects of Macro-Level Interventions on Addictive Behavior”*, *Substance Use & Misuse*, Volume 36, Number 13, pages 1901–1922.
- Purshouse, R.C., Meier, P.S., Brennan, A., Taylor, K.B. and Rafia, R. (2010) *“Estimated effect of alcohol pricing policies on health and health economic outcomes in England: an epidemiological model”*, *The Lancet*, Volume 375, Issue 9723, pages 1355–1364.
- Purshouse, R.C., Meng, Y., Rafia, R., Brennan, A. and Meier, P. (2009) *“Model-Based Appraisal of Alcohol Minimum Pricing and Off-Licensed Trade Discount Bans in Scotland: A Scottish adaptation of the Sheffield Alcohol Policy. Model version 2”*, Department of Economics, Sheffield University.

Saffer, H., Dave, D., Grossman, M., (2012) *“Behavioral Economics and the Demand for Alcohol: Results from the NLSY97”*, National Bureau of Economic Research Working Paper 18180.

Sloan, F.A., Reilly, B.A. and Schenzler, C. (1994) *“Effects of Prices, Civil and Criminal Sanctions, and Law Enforcement on Alcohol Mortality”*, Journal of Alcohol Studies, 55, pages 454-465.

Stout, E.M, Sloan, F.A., Liang, L. and Davies, H.H. (2000) *“Reducing Harmful Alcohol-Related Behaviours: Effective Regulatory Methods”*, Journal of Studies on Alcohol, 61(3):402-12.

Wagenaar, A.C., Salois, M.J. and Komro, K.A. (2009) *“Effects of beverage alcohol price and tax levels on drinking: a meta-analysis of 1003 estimates from 112 studies”*, Addiction, Volume 104, Issue 2, pages 179–190.

Wojcieszak, M. and Price, V. (2009) *“What Underlies the False Consensus Effect? How Personal Opinion and Disagreement Affect Perception of Public Opinion”* Journal of Public Opinion Research, Volume 21, Issue 1, pages 25-46.

Xu, X. and Chaloupka, F.J. (2011) *“The Effects of Prices on Alcohol Use and its Consequences”*, Alcohol Research and Health, Volume 34, Issue 2.

Annex 1 List of studies considered in the literature review

Table 3: Main evidence (in order of appearance)					
Paper	Type of research	Publication	Peer-reviewed	Citations ¹	Funding
Manning et al. (1995)	Primary data analysis	Journal of Health Economics	Yes	235	National Institute on Alcohol Abuse and Alcoholism
Ayyagari et al (2009)	Primary data analysis	NBER working paper	No	7	National Institute on Alcohol Abuse and Alcoholism
An and Sturm (2011)	Primary data analysis	Journal of Mental Health Policy and Economics	Yes	0	National Institute on Alcohol Abuse and Alcoholism / National Institute of Environmental Health Sciences
Dave and Saffer (2012)	Primary data analysis	NBER working paper	No	1	National Institute on Alcohol Abuse and Alcoholism
Meier et al (2008)	Primary data analysis	Department of Health publication	No ²	13 ³	Department of Health Policy Research Programme
Wagenaar et al (2009)	Meta-analysis	Addiction	Yes	150	Robert Wood Johnson Foundation
Cook et al (2011)	Primary data analysis	BMC Public Health	Yes	1	Government Office North West as part of the Big Drink Debate
Ipsos (2009)	Primary data analysis	Brewers of Europe publication	No	0	Brewers of Europe
Herzfeld et al (2011)	Primary data analysis	Iowa State University working paper	No	0	N.A.
Farrel et al (2003)	Primary data analysis	Journal of Health Economics	Yes	51	National Institute on Alcohol Abuse and Alcoholism / UnitedHealth Group
Helakorpi et al (2010)	Primary data analysis	Alcohol and Alcoholism	Yes	7	N.A.
Keng and Huffman (2010)	Primary data analysis	Journal of Population Economics	Yes	15	Iowa Agriculture and Home Economics Experiment Station
Stout et al (200)	Primary data analysis	Journal of Studies on Alcohol	Yes	40	National Institute on Alcohol Abuse and Alcoholism
Hunt et al (2011)	Literature review	RAND Europe publication	Yes	2	Home Office
Home Office (2011)	Literature review	Home Office publication	No	0	Home Office
Xu and Chaplounka (2011)	Literature review	Alcohol Research and Health	Yes	0	National Institute on Alcohol Abuse and Alcoholism
Rabinovich et al (2009)	Literature review	RAND Europe publication	Yes	24	European Commission DG Health and Consumers
Booth et al (2008)	Literature review	Department of Health publication	Yes	24	Department of Health Policy Research Programme

Table 3: Main evidence (in order of appearance)					
Paper	Type of research	Publication	Peer-reviewed	Citations ¹	Funding
Elder et al (2010)	Literature review	American Journal of Preventive Medicine	Yes	23	National Centre for Chronic Disease Prevention and Health Promotion / National Centre for Health Marketing
Chaloupka et al (2002)	Literature review	Alcohol Research and Health	Yes	299	National Institute on Alcohol Abuse and Alcoholism
Cook and More (2002)	Literature review	Health Affairs	Yes	107	Princeton University's Centre for Wellbeing
Heeb et al (2003)	Primary data analysis / Literature review	Addiction	Yes	55	Swiss Alcohol Board / National Institute on Alcohol Abuse and Alcoholism

Note: 1. Number of citations is given by Google Scholar's "Cited by" count. 2. Although the original study was not peer reviewed, the results from this study have appeared in subsequent papers by the same authors, such as Meier, Purshouse and Brennan (2010a) "Policy options for alcohol price regulation: the importance of modelling population heterogeneity", which have been published in peer reviewed journals. 3. The results from this study have appeared in subsequent papers by the same authors, such as Meier, Purshouse and Brennan (2010a) "Policy options for alcohol price regulation: the importance of modelling population heterogeneity", which has 26 citations.

Annex 2 Technical details of approaches used to analyse differential price responsiveness

This annex presents technical details of the approaches used in different studies to measure and compare the aggregate price responsiveness of different drinker types, including variable definitions, data sources and modelling techniques.

Manning et al (1995) analyse consumption data from the US National Health Interview Survey (NHIS) 1983, combined with price data for beer, wine and spirits from the American Chamber of Commerce Researchers Association. These prices are converted into prices per ounce of pure alcohol and combined into an overall price index. The size of the sample for their analysis is 18,844. A two-part regression model (ubiquitous in health economics literature, according to Ayyagari et al, 2009) is used to separate one random variable, alcohol consumption, into two random variables: 1) whether a person drinks, and 2) how much a person drinks if they drink at all. Being a 'current drinker' is defined as having had a drink in the last 12 months, and the probability that an individual is a current drinker is modelled as a logit equation (i.e. this equation analyses factors influencing the decision to drink). For current drinkers, the authors examine average daily consumption of pure alcohol, the natural log of which is the dependent variable in the second equation of the two-part model (estimated using OLS). To differentiate between heavy and moderate drinkers they use quantile regressions, estimating models for 11 quantiles along the drinking level distribution (see Table 2).

Meier et al (2008) categorise drinkers as either 'moderate', 'hazardous' or 'harmful' (see Table 2). For each of these drinker categories, they estimate own-price and cross-price elasticities of demand for 16 categories of alcoholic beverage (beers, wine, spirits, and 'ready-to-drinks', split by on- or off-trade, and split by low-priced and high-priced). Their findings on cross-price elasticity of demand and substitution between different types of alcohol in response to price changes are discussed in Chapter 3. For moderate drinkers and a combined hazardous and harmful drinkers group, they also generate aggregate price elasticity estimates for total alcohol purchasing. These estimates are based on data from the Expenditure and Food Survey (EFS) between 2001 and 2005, which provides individual-level data on the volume of alcohol purchased and the price paid over the last two-weeks, as well as information on the purchaser's characteristics. Over the five years the authors have records for 69,618 individuals.

Ayyagari et al (2009) use individual-level data from the US Health and Retirement Survey (HRS) between 1996 and 2004. The HRS is a nationally representative longitudinal survey, providing the authors with a maximum sample of the 71,802 observations. A caveat of the study is that the sample for analysis is skewed towards older adults. From the HRS the authors have a variable for the number of alcoholic drinks consumed per day for each individual, which is the dependent variable in the econometric analysis. The drinks per day measure includes any type of the alcohol drink (i.e. it does not differentiate between a glass of beer, a glass of wine etc. The explanatory variable of interest is the natural logarithm of the average alcohol price (based on state level data on prices on wine, beer and spirits, standardized per ounce of ethanol, adjusted for state variation in cost of living and inflation). The authors employ finite mixture models (FMM) in order to allow price responsiveness to vary by latent population sub-groups which cannot be identified using simple groups such as age, race or gender. FMM allows these population sub-groups to be identified and, importantly, characterised in terms of the variables included in the model (such as

level of drinking). The authors' discussion of the modelling approach suggests that FMM has a number of advantages over the methods used by Manning et al (i.e. two-part models and quantile regressions).

An and Sturm (2011) investigate differences in aggregate *tax* elasticities across different types of drinkers. It is common for studies to use alcohol taxes as a proxy for price since changes in the two are strongly correlated over time and taxation is a deliberate alcohol pricing policy.⁴⁶ They use individual-level data on alcohol consumption from the US Behavioural Risk Factor Surveillance System (BRFSS) from 1984 to 2009 (the total sample size included in their models is 3,921,943), supplemented with tax data from the Federation of Tax Administrators and the U.S. Brewers' Association Brewers' Almanac. Similar to Manning et al (1995), they establish a two-part regression model, the first equation of which constitutes a probit regression estimating the effect of alcohol taxes on the decision to drink alcohol. The second equation applies OLS regression in order to evaluate the impact of alcohol taxes on the number of standard drinks that an individual consumes per month. A standard drink is defined as any drink containing 14g of pure alcohol, and the dependent variable for the second equation is the natural log of the number of standard drinks per month. For both equations, the independent variable of interest is the natural log of the excise tax on beer (measured as the sum of state and federal taxes per gallon of beer), which the authors use as a proxy for the average tax level across all alcoholic drinks.⁴⁷ In order to assess potential differences in alcohol tax sensitivities across drinker types they categorise drinkers as light, moderate or heavy (see Table 2) and estimate the impact of tax on the level of consumption for each type in separate regressions.

Cook et al (2011) examine perceptions of how alcohol consumption would change if prices were to increase or decrease based on data from a convenience survey of 22,780 drinkers in North West England in 2008. Survey respondents were asked how they think a) 'low prices and discounts' and b) 'increased alcohol prices' would impact on 'people's alcohol use'. The options available were 'increase', 'decrease' or 'no change'. The authors argue that the respondents projected their views in a 'false consensus effect',⁴⁸ and therefore they conjecture that the beliefs expressed refer to respondents own anticipated reactions to the two pricing scenarios. A three-state price elasticity variable is constructed defining each respondent as: a) 'price inelastic' if they reported 'no change' for both questions; b) 'completely price elastic' if they reported that both price conditions would affect behaviour (in the expected direction); or c) 'lower price elastic only' if they reported that only the low price condition affects behaviour.⁴⁹ The price elasticity variable is modelled using forward stepwise multinomial logistic regression, with 'price inelastic' as the reference category. However, while the initial explanatory variables include drinking level, income level and the interaction between income and drinking, only the interaction term is retained after the stepwise

⁴⁶ For example, Dave and Saffer (2007) estimate tax elasticities and translate these into price elasticities using the method set out by Kenkel (2005).

⁴⁷ According to Dave and Saffer (2007) using the state excise tax on beer as a proxy for the cost of alcohol has the benefit that the tax bypasses the simultaneity between price and demand, since changes in tax are plausibly exogenous to an individual's alcohol demand, and also changes in tax rates over time are strongly correlated with changes in beverage price. They estimate beer tax elasticities and translate these into price elasticities.

⁴⁸ See Wojcieszak and Price (2009) for information on the 'false consensus effect'.

⁴⁹ Few respondents (392) were in the 'higher price elastic only' category (i.e. reported that higher prices decrease people's consumption but low prices cause no change) and so were excluded.

procedure, suggesting that drinking level only influences price responsiveness in combination with income.

Herzfeld et al (2011) examine the impact of individual characteristics, including initial consumption level, on changes in alcohol consumption over a ten year period in Russia using panel data from the Russian Longitudinal Monitoring Survey (RLMS) between 1994 and 2004 and the Russian Statistical Yearbook (RSY). In their econometric modelling, the dependent variable is the change between 1994 and 2004 in an individual's self-reported consumption of pure alcohol (in grams per day) over the last 30 days. The explanatory variable of interest is the change between 1994 and 2004 in the aggregate price of alcohol relative to the aggregate price of food.⁵⁰ The authors implement Heckman's two-step method, where the first step is a probit model of the decision to consume any alcohol and the second step is a regression of consumption conditional on being a drinker. The modelling is undertaken for the full sample and, separately, for those above and below median alcohol consumption in 1994 (see Table 2).

Ipsos (2009) surveyed a representative sample of consumers in Denmark, Germany, Portugal and the Czech Republic, with around 1,000 respondents per country. Respondents were asked about their alcohol consumption habits, including how often they drink and how many drinks they have on a 'typical' occasion. Consumers were also asked how they would be likely to react if the price of all drinks were to increase by 25%. The report presents the shares of consumers who replied that they would 'drink less in general', 'drink less often', 'drink the same', or 'change purchasing behaviour', for the whole sample and for various sub-groups of drinkers.

Saffer et al (2012) provide a theoretical rationalisation for the more elastic demand of moderate drinkers relative to heavy drinkers. Their paper also provides new empirical work based on the United States NLSY97 from 2002-2009. The NLSY97 is an annual longitudinal, nationally representative sample of 8,984 individuals who were 12 to 16 years old on December 31st 1996. The average age in the sample is 24, so the results relate to relatively young adult drinkers. The empirical work includes both FMM results and quantile regression results and finds that moderate drinkers have more elastic demand than heavy drinkers. The elasticities reported are for alcohol consumption given participation (i.e. the intensive margin). That is, non-drinkers are excluded from the analysis. The FMM results are similar to those reported in Ayyagari et al (2009) and the quantile regression results are similar to those found by Manning et al (1995).

⁵⁰ Where the aggregate alcohol price is a weighted average across different beverage types at community level, and the aggregate price of food includes prices for all different types of foods for which expenditure data are available.

Annex 3 Findings for groups identified by characteristics other than alcohol consumption

This section covers studies which examine differential alcohol price responsiveness across drinker types based on age, gender, income and education level. Although it is often hard to draw specific conclusions about how particular drinker characteristics influence price responsiveness, since in many cases the findings of different studies do not align, the overall picture is that there is significant heterogeneity between different groups.

A3.1 Age

Gallet (2007) undertakes a meta-analysis of alcohol price elasticities from 132 studies, presenting median price elasticity estimates and regressing elasticity estimates on the attributes of the original studies. Since price elasticities are negative, a positive coefficient on a variable in the regression implies that that variable causes price sensitivity to be lower. The median alcohol price elasticity estimate across all studies is -0.497.

The analysis includes a number of price elasticity estimates which coincide with specific age groups, defined as ‘teens’ (less than 18 years), ‘young adults’ (18 to 24 years) and ‘adults’ (older than 24 years). Based on the simple median elasticity estimates for these age groups, and also on the meta-analysis regression results, adults appear to be more responsive to price than young adults.

The policy simulations conducted by **Meier et al (2008)** at the University of Sheffield showed that youth consumption of alcohol is more responsive to price than consumption by the population in general. Their study found that a price increase of 10% across all beverages would decrease the average alcohol consumption of 11 to 18 year olds by 5.3%, relative to 4.4% for the general population.

Cook et al (2011) examine perceptions of how alcohol consumption would change if prices were to change and how these perceptions vary across drinkers in different age groups. The authors use data from a 2008 survey of 22,780 drinkers in North West England. The survey respondents were asked how they think a) ‘low prices and discounts’ and b) ‘increased alcohol prices’ would impact on ‘people’s alcohol use’. The options available were ‘increase’, ‘decrease’ or ‘no change’. The authors argue that the respondents projected their views in a ‘false consensus effect’,⁵¹ and therefore they assume that the beliefs expressed refer to respondents own anticipated reactions to the two pricing strategies.

The authors carry out a regression analysis using a three-state price elasticity variable, constructed by defining each respondent as: a) ‘price inelastic’ if they reported ‘no change’ for both questions; b) ‘completely price elastic’ if they reported that both price conditions would affect behaviour (in

⁵¹ See Wojcieszak and Price (2009) for information on the ‘false consensus effect’.

the expected direction); or c) 'lower price elastic only' if they reported that only the low price condition affects behaviour.⁵²

The price elasticity variable is modelled using forward stepwise multinomial logistic regression, with 'price inelastic' as the reference category, including age group dummies among the explanatory variables (18 to 24, 25 to 34, 35 to 44, 45 to 64, and 65+, with the latter used as the reference category). The results indicate that age is not a significant predictor of being *lower price elastic*, but also that the youngest age group (18-24) is significantly more likely to be *completely price elastic* than the oldest age group.

Helakorpi et al (2010) investigate the frequency of 'moderate to heavy drinking' and 'heavy episodic drinking' in Finland before and after alcohol taxes were reduced by a third, on average, in March 2004. For men (women) 'moderate to heavy drinking' is defined as having 8 (5) drinks per week, and 'heavy episodic drinking' is defined as having 6 or more drinks on a single occasion once a week (month), where a standard drink is defined as a drink containing 11-13g of pure alcohol. The authors conclude that, following the reduction in alcohol prices, alcohol consumption increased especially among those aged 45–64.

Dave and Saffer (2007) examine whether price and tax elasticities of demand for alcohol vary according to an individual's age and risk tolerance. The authors estimate beer excise tax elasticity of demand for alcohol, arguing that excise tax on beer serves as a good proxy for the price of alcohol,⁵³ and formally convert these tax elasticity estimates into price elasticity estimates using the method set out by Kenkel (2005). The analysis uses individual-level data from the US Panel Study of Income Dynamics (PSID) for 1999, 2001 and 2003 and from the US Health and Retirement Study (HRS) for 1992 to 2005.

The authors estimate both participation elasticity (i.e. the impact of taxes and prices on the decision to drink at all) using a probit regression and consumption level elasticity (i.e. the impact of taxes and prices on daily number of drinks consumed conditional on being a drinker) within a two-part modelling framework (such as that used by Manning et al, 1995).⁵⁴ Comparing younger adults (aged 21 to 54) with older adults (aged 55 and over), responsiveness to taxes and prices is found to be higher among the older sub-population. In particular, tax elasticity is estimated at -0.05 for younger adults, relative to -0.20 for older adults.

Arnoult and Tiffin (2010) investigate the impact of introducing a minimum price of 50p per unit of alcohol in the UK, analysing the effects of the resulting increases in prices using price elasticity estimates. Household data on expenditure on various alcoholic drinks – consumed either at home

⁵² Few respondents (392) were in the 'higher price elastic only' category (i.e. reported that higher prices decrease people's consumption but low prices cause no change) and so were excluded.

⁵³ This argument is made on several grounds. Firstly, the tax bypasses the simultaneity between price and demand since changes in the tax are plausibly exogenous to an individual's alcohol demand. Further, changes in excise tax rates over time are strongly correlated with changes in beverage price (they note that studies have shown that a one-cent increase in the excise tax raises the price by at least as much). In addition, excise tax rates on beer, wine and liquor are highly correlated, as are their prices, so beer tax provides a good proxy for the cost of alcohol while bypassing issues of colinearity with including multiple tax rates in the specification. (See Dave and Saffer, 2007, page 14.)

⁵⁴ For consumption level elasticity estimation the dependent variable is the natural log of standard drinks consumed daily, where a standard drink is considered to be the amount of beverage containing approximately 0.5 ounces of alcohol (i.e. about 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of distilled spirits).

(‘drinking in’) or at pubs/restaurants (‘drinking out’) – and food items are taken from the Expenditure and Food Survey 2005-2006. The sample stratified is by age, gender and household income (among other characteristics). The authors use an Almost Ideal Demand System methodology to estimate elasticity. The analysis by age group finds that for *drinking in* those aged over 60 are more price sensitive (elasticity -0.84), whilst those aged under 30 are less price sensitive (elasticity -0.78). For *drinking out* those aged under 30 are more price sensitive (elasticity -0.94) whereas those aged 30 to 45 are less price sensitive (elasticity -0.91).

Ayyagari et al (2009) estimate the aggregate price elasticity of demand for alcohol based on data from the US Health and Retirement Survey between 1996 and 2004. The authors use finite mixture models (FMM) in order to allow price responsiveness to vary by latent population sub-groups. This approach allows these population sub-groups to be identified and, importantly, characterised in terms of the variables included in the model, including age, gender and years of education.

The study recovers two latent sub-groups, the largest of which (75% of the sample) is significantly responsive to price, with a coefficient on the price variable of -1.6 (p-value < 0.001). The second, smaller (25% of the sample) sub-group is unresponsive to price, with an insignificant coefficient on the price variable (equal to -0.035). Analysis of the determinants of being in either group shows that the likelihood that an individual is in the price elastic group increases with age.

According to **Rabinovich et al (2009)** it is difficult to assess the link between economic factors and youth drinking and it is unclear whether youth drinkers are more or less affected by price than the general population. They cite the assertion made by Pacula and Chaloupka (2001) that analyses “consistently find that the consumption of addictive substances by youths and young adults is more sensitive to changes in price than consumption by adults”, and reference the study by Meier et al (2008) as an example which supports this hypothesis. However, conversely, they also note that Gallet (2007) finds that price elasticities for youth drinking tend to be less elastic.

A3.2 Gender

The meta-analysis undertaken by **Gallet (2007)** includes a number of gender-specific price elasticity estimates. Firstly, Gallet (2007) reports the median price elasticity estimates for men and women across a number of studies, and based on these median estimates it seems that women are more responsive to price than men. However, based on more sophisticated meta-analysis, where characteristics of the original studies are included as explanatory variables in a meta-analysis regression, the impact of gender on price sensitivity is found to be insignificant.

As discussed above, **Cook et al (2011)** examine perceptions of how alcohol consumption would change if prices were to change using data from a survey where respondents were asked how they think a) ‘low prices and discounts’ and b) ‘increased alcohol prices’ would impact on ‘people’s alcohol use’. The authors constructed a price elasticity variable defining respondents as a) ‘price inelastic’ if they reported ‘no change’ for both questions, b) ‘completely price elastic’ if they reported that both price conditions would affect behaviour (in the expected direction), or c) ‘lower price elastic only’ if they reported that only the low price condition affects behaviour. Regression analysis shows that males are significantly less likely to be *lower price elastic*, but significantly more likely to be *completely price elastic*.

Helakorpi et al (2010) examine the incidence of ‘moderate to heavy drinking’ and ‘heavy episodic drinking’ in Finland before and after taxes on alcohol were significantly reduced in March 2004.⁵⁵ The main difference between men and women observed in the study is the differing influence of education level on the price responsiveness of these two groups:

- among men, both moderate to heavy drinking and heavy episodic drinking increased in the lowest educational group; whereas
- among women, moderate to heavy drinking increased mainly in the lowest and intermediate educational groups, while the greatest increases for heavy episodic drinking were in the intermediate and highest educational groups.

Arnoult and Tiffin (2010) use an Almost Ideal Demand System approach to estimate alcohol price elasticity for consumption at home (‘drinking in’) and consumption at pubs/restaurants (‘drinking out’), by gender. For both *drinking in* and *drinking out* and the study finds no difference between men and women (for drinking in the elasticity is -0.82 for both men and women, and for drinking out it is -0.92 for both men and women).

Using individual-level data from the USA, **Ayyagari et al (2009)** employ finite mixture models (FMM) in order to allow price sensitivity to vary by latent population sub-groups. FMM enables the authors to identify these sub-groups and also to characterise the sub-groups in terms of the variables included in the model, such as age, gender and years of education. Two latent sub-groups are found, only one of which is responsive to price. Males are significantly more likely to be in the unresponsive sub-group.

A3.3 Income

Manning et al (1995) investigate whether the aggregate price responsiveness of the demand for alcohol varies according to a drinker’s income level. The authors analyse alcohol consumption data from the 1983 US National Health Interview Survey, combined with price data from the American Chamber of Commerce Researchers Association. Their two-part regression model separates one random variable, alcohol consumption, into two random variables: 1) whether a person drinks, and 2) how much a person drinks if they drink at all.

The impact of income on price responsiveness is analysed by including an interaction term between price and income in their econometric model. The statistically significant coefficient on this interaction term of -0.67 implies that as income rises the price elasticity of alcohol demand becomes more elastic. That is, drinkers with higher incomes are more sensitive to price changes.

Cook et al (2011) include interaction terms between income and alcohol consumption level as explanatory variables in their regression of aggregate alcohol price elasticity. They find that several of these terms are statistically significant: for example, low income light drinkers are significantly more price elastic than high income heavy drinkers. Thus, their analysis shows that in combination income and drinking level affect price sensitivity.

⁵⁵ For men (women) ‘moderate to heavy drinking’ is defined as having 8 (5) drinks per week, and ‘heavy episodic drinking’ is defined as having 6 or more drinks on a single occasion once a week (month), where a standard drink is defined as a drink containing 11-13g of pure alcohol. The authors conclude that, following the reduction in alcohol prices, alcohol consumption increased especially among those aged 45–64.

A3.4 Education

Ayyagari et al (2009) estimate the aggregate price elasticity of demand for alcohol using individual-level data from the US Health and Retirement Survey between 1996 and 2004. The authors employ finite mixture models (FMM) in order to allow price responsiveness to vary by latent population sub-groups. FMM allows these population sub-groups to be identified and, importantly, characterised in terms of the variables included in the model, including age, gender and years of education.

The study finds two latent sub-groups, the largest of which (75% of the sample) is significantly responsive to price, with a coefficient on the price variable of -1.6 (p-value < 0.001). The second, smaller (25% of the sample) sub-group is unresponsive to price, with an insignificant coefficient on the price variable (equal to -0.035). Analysis of the determinants of being in either group shows that the likelihood that an individual is in the price elastic group decreases with years of education.

