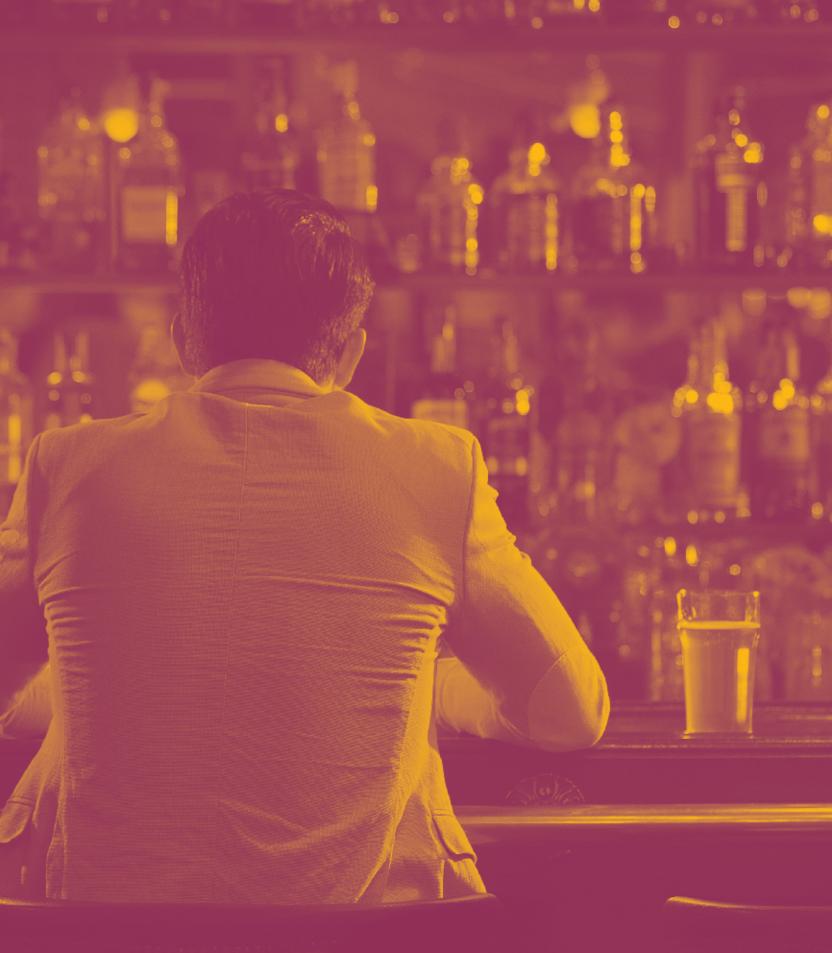
Part 2 Monetary Policy, Fiscal Policy and Labour Markets

Chapter

Equal tax for equal alcohol? Beverage types and antisocial and unlawful behaviours

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This chapter explores the links between alcohol beverage types and antisocial and unlawful behaviours and provides valuable empirical evidence to support the case for taxing alcohol with differentiated volumetric rates by beverage types. The results show that regularstrength beer and pre-mixed spirits in a can rank the highest in their links to negative behaviours, followed by mid-strength beer, cask wine, and bottled spirits. Conversely, drinking low strength beer or fortified wine reduces the probability of these risky and unlawful behaviours. Bottled wine is shown to be associated with an elevated chance of drink driving but a reduced chance of other negative behaviours. In contrast to the existing volumetric tax rates for per litre of alcohol, of all harmful beverage types, cask wine appears to be significantly under-taxed relative to its external costs to society.

INTRODUCTION

Why do we care?

Binge drinking and its related adverse effects have long been a major policy concern in many countries (Yang et al., 2016). Although there is evidence showing that moderate alcohol consumption benefits health among middle-aged and older people (for instance, Gaziano et al., 1993; Rimm, 1996; Fagrell et al., 1999; Malinski et al., 2004), the toll of excessive alcohol consumption or binge drinking on many societies significantly exceeds these benefits.

As in many other developed countries, alcohol consumption is an intrinsic part of Australian culture, and it plays a central role in most people's social lives. However, excessive alcohol consumption results in significant costs to the health sector, justice system, transport sector, workplaces and several other areas, including the welfare system due to costs arising from family violence and child abuse (Leonard and Jacob, 1988). The associated costs are diverse and immense in Australia and globally. For example, the social cost of alcohol use in 2017-2018 was estimated to be nearly \$67 billion in Australia (Whetton et al., 2021).

Recent statistics show that consumption of alcohol at harmful levels in Australia is considerable. For instance, according to data from the Australian National Drug Strategy Household Survey (NDSHS) (AIHW, 2020), one in four Australians reported drinking at a risky level on a single occasion at least monthly in 2019. Since the onset of the COVID-19 pandemic, there have been growing concerns that alcohol consumption and harmful behaviour resulting from such consumption have increased (OECD, 2021). Findings from prior major social and economic upheavals support that the increased stress, financial uncertainty and unemployment experienced during COVID-19 could result in long-term changes in alcohol use patterns and related health and social consequences (Acuff et al., 2020; de Goeij et al., 2015; North et al., 2011).

Excessive drinking is commonly linked to behaviours that are antisocial, harmful or even criminal, such as risky sexual activities and violent behaviours (Rossow et al., 1999; Champion et al., 2004; Carpenter, 2005; Morojele et al., 2006). On the other hand, alcohol consumption in conjunction with normal activities, such as driving or swimming, can increase the probability that such activities result in harm to self or others (Kenkel, 1993; Ruhm, 1996; Cook and Moore, 2002; Hamilton and Schmidt, 2014). Some of the negative costs from these behaviours are external to the drinkers and borne by society, such as health-care costs of alcohol abuse in public-funded health systems, road accidents from drink driving, and physical and verbal abuse to family members and the wider community. Existing empirical evidence on the association between alcohol consumption and alcoholrelated risky and abusive behaviours mostly focuses on alcohol as an aggregated product (for example, Adlaf and Smart, 1983; Jonah, 1986; Yu and Williford, 1993; Greenfield and Weisner, 1995; Weiser et al., 2006). Empirical studies for differentiated alcohol products are few and only link a small spectrum of adverse behaviours—such as drink driving, road accidents, assaults and homicides—to beer and spirits rather than wine consumption (see Berger and Snortum, 1985; Smart, 1996; Norstrom, 1998; Stockwell et al., 1998; Naimi et al., 2007; Siegel et al., 2011; Dey et al., 2014). To some extent, the findings vary by population group and country, with adverse behaviours having a greater association with beer in older adults and in European countries, and a greater association with spirits in younger adults and in the United States where liquor is more popular.

The current alcohol tax policy in Australia and how we got there

A critical policy lever governments around the world use to curb alcohol abuse is alcohol taxation. Increasing taxes is considered the most effective intervention among alcohol policies aimed at reducing excessive drinking (Wagenaar et al., 2010; Xu and Chaloupka, 2011). Previous studies show that high-income countries with higher alcohol excise taxes tend to experience lower alcohol consumption, lower incidence of binge drinking, fewer alcohol-related traffic accidents, and lower mortality/sudden deaths from alcohol-related disease (Chaloupka et al., 1993; Koski et al., 2007; Wagenaar et al., 2009; Delcher et al., 2012; Xuan et al., 2015).

Australia currently has in place a complex alcohol tax system where different beverages are taxed differently (PBO, 2015). Beer and spirits are taxed on a volumetric basis (for example, by alcohol concentration), but wine is taxed on the wholesale value (an ad valorem tax) (Freebairn, 2010, Table 1). When converted to an effective rate of per litre of alcohol (LAL), based on the 2007-2008 data, the volumetric tax rates vary greatly by beverage (Srivastava et al., 2015), with cask wine paying effectively \$3/LAL, bottled wines \$14-\$33/LAL by price, beer \$19-\$31/LAL by alcohol strength, ready-to-drink pre-mixed spirits \$41-\$43/LAL, and straight spirits \$66/LAL.

Alcohol taxation in Australia has been the subject of ongoing debate among health professionals, industry lobby groups, academics and policy-makers, with parliamentary reviews (Henry et al., 2009; Treasury, 2011). Many argue that the current anomalous system is the result of historic ad hoc responses to industry lobby groups rather than a careful design informed by the external costs associated with different alcoholic beverages, and that it needs to be reviewed and reformed (see, for example, submissions to the Tax Forum by Treasury, 2011). The spirit industry argues for the positive contribution of wine production and consumption to areas such as tourism. From a policy perspective it would be instrumental to examine whether these rates relate to the negative external costs per LAL for these drink types.

Key mechanisms for alcohol taxation

The economic argument for alcohol tax is the need for correction of market failures and negative external costs that are associated with alcohol consumption. Challenging the paternalistic view, economists (see Pogue and Sgontz, 1989; Clarke, 2008; Freebairn, 2010) consider alcohol consumption as having both benefits and costs. If all consumers are rational decision makers and are fully aware of all the benefits and costs associated with alcohol consumption, they will choose consumption levels accordingly, and the market equilibrium price for alcohol will be optimal and high enough to reflect both the costs and the benefits.

However, there are many reasons to believe that serious market failure exists in alcohol consumption, and the scale of alcohol abuse we observe in many societies is a testament. For example, incomplete information regarding the long-term health impact and addictive nature of alcohol consumption in binge drinkers' private decision making for consumption is an example of market failure. Another example is the underestimation of future harms due to lack of willpower. More importantly, significant external costs of excessive drinking are borne by society. These include the health-care costs of alcohol abuse in public-funded health systems (such as in Australia), road accidents from drink driving, and antisocial behaviours when intoxicated, including public nuisance, damage and theft of property, and physical and verbal abuse to family members and the wider community. Therefore a more favourable economic approach to alcohol policy is to correct such market failure by imposing an appropriate amount of tax to any such consumption based on the negative external costs it generates, in order to achieve the highest efficiency at the societal level.

The current tax structures in Australia have been subject to very little change in recent years, except for excise on pre-mixed beverages which, following the Henry Tax Review (Henry et al., 2009), are now taxed at the same rate as straight spirits. Motivated by the need to reduce cheap cask wine abuse and encourage the production and consumption of low-alcohol products, both the Henry Tax Review and Freebairn (2010) propose a simple 'equal tax for equal alcohol' approach by applying a flat volumetric tax with an equal tax rate per LAL to all beverage types. This approach is also supported by the Australian National Preventative Health Task Force (2009).

Nonetheless, such a simple but blunt measure that implicitly associates the degree of negative external costs only with the volume of alcohol regardless of product types will reduce consumption—not only for excessive drinkers but also for responsible consumers with low to moderate levels of consumption who have already accounted for all negative impacts as private costs in their consumption decision making, thus leading to efficiency loss. Alternatively, as opposed to taxing heterogeneous consumers, taxing the products that are more likely to be associated with negative external costs or consumed by individuals who are more likely to be involved in risky and abusive behaviours, would seem to be a more feasible approach.

No major change has eventuated in the alcohol tax structure from the Henry Tax Review and discussions on proposed reforms are ongoing. As pointed out by Freebairn (2010), the choice between a simpler flat rate and a differentiated rate for beverage types would depend on compelling evidence that the marginal external costs vary by type of alcohol product. Indeed, recent debates and recommendations in Australia seem to agree on the need for greater empirical evidence. Although a precise calculation of external costs per LAL for different beverages would be a difficult task, any investigation based on available data that quantify the negative external costs of excessive consumption by specific alcohol beverage types would be very informative.

This study provides empirical evidence to support the case for taxing alcohol with differentiated volumetric rates by beverage type. The empirical analysis suggests that equal alcohol in different product forms is most likely to be associated with different harms, thus rendering no support for the 'equal tax for equal alcohol' proposal or a common volumetric tax.

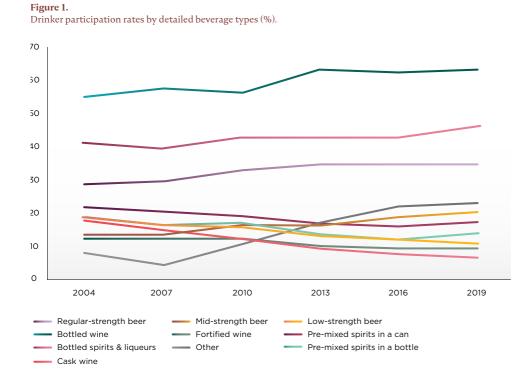
DATA

I explore the link between different alcohol beverage types and antisocial behaviour using data from the most recent six waves of the NDSHS¹ from 2004 to 2019. This time span allows study of a large sample of 149,091 survey respondents with diverse demographic and socio-economic backgrounds, to produce results that are most representative and robust.

Regular-strength beer, bottled wine and bottled spirits are the preferred drinks among Australians

The study focuses on those who report having consumed alcohol in the past year; the rest are defined as abstainers. More than 74 percent of the sample reported themselves as drinkers in each wave of the survey. This results in a sample of 113,457 drinkers. From the survey data, we can identify these drinkers' drinking preferences for 10 detailed beverage types,² including regular-strength beer, mid-strength beer, low-strength beer, cask wine, bottled wine, fortified wine, pre-mixed spirits in a can, pre-mixed spirits in a bottle, bottled spirits and liqueurs, and other alcohol. Figure 1 displays participation rates by 10 types of alcoholic drinks. Regular-strength beer, bottled wine, and bottled spirits and liqueurs are the three most preferred drinks. Pre-mixed spirits, which have gained popularity among young people in the last decade, also (collectively) demonstrate significant participation rates.

When we break down the participation rates by age and gender, as shown in Figure 2, we find that canned and bottled pre-mixed spirits are more popular among youth and young adults aged 12 to 29, with participation rates declining remarkably with age. In contrast, bottled wine is more popular among middle-aged and elderly people (those aged 40+). In terms of gender difference, regular-strength beer is more popular with men than women, irrespective of age. In contrast, women have a higher preference for bottled wine than men across all age groups.



The NDSHS is a nationally representative cross-sectional survey of the non-institutionalised Australian civilian population and is administered by the Australian Institute of Health and Welfare. A multi-stage, stratified area sample design ensures a random sample of households in each geographical stratum. The survey provides information on drug use patterns, attitudes and behaviour. It also provides a wide range of information on respondents' demographic and socio-economic backgrounds.

² The survey has several questions on individuals' consumption of various drink types. One of the questions relates to their drinking preference where respondents are required to answer the question, 'What types of alcohol do you usually drink? (Mark all the types of drinks that apply)'. I use this information to construct 10 dichotomous variables to indicate respondents' usual drinking preferences.

Antisocial behaviour

This study's main interest is the antisocial behaviour of individuals that is undertaken under the influence of alcohol. In the survey data, we can identify and focus on eight antisocial and unlawful behaviours drinkers reported to have undertaken while under the influence of alcohol:³ drove a motor vehicle; operated a boat; operated hazardous machinery; created a public disturbance or nuisance; caused damage to property; stole money, goods or property; verbally abused someone; and physically abused someone.

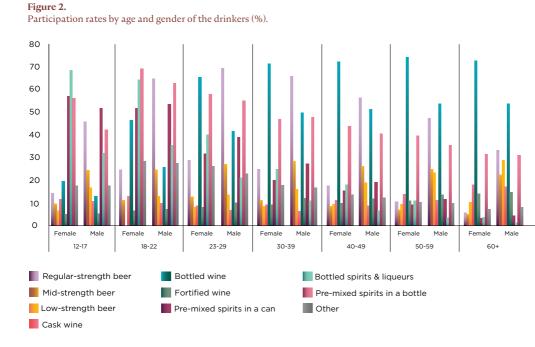
Figure 3 displays the proportions of respondents in the sample who had at least an alcoholic drink of any kind in the last 12 months and indulged in any of these antisocial and unlawful behaviours while under the influence of alcohol, across the six waves of the survey from 2004 to 2019. It shows that drink driving and verbal abuse are the two most common antisocial behaviours undertaken by Australians under the influence of alcohol. The prevalence of any of these behaviours can potentially impose costs resulting from legal action, health-care costs and lost productivity. It is also important to note that verbally abusing someone is a form of emotional abuse that can have serious short- and long-term consequences on the victim's physical and mental health. As such, the resulting cost could be an indirect health-care cost or an intangible emotional cost.

Cost of alcoholic beverages

To study the causal link between alcoholic beverage types and antisocial behaviour. it is necessary to include beverage-specific prices in the analysis. As the NDSHS does not provide data on beverage prices, data on the value and volume of sales of off-premise consumption for specific drink types for the survey years of 2004, 2007, 2010 and 2013⁴ were purchased from AC Nielsen.⁵ Implicit prices per litre of beverage were then constructed by dividing the value of sales measured in dollars by the respective volume of sales measured in litres of beverage. The statelevel monthly prices were then converted to state-level annual average prices and matched to the dataset by survey year and state. Individual-specific beverage prices were derived using the aggregated state-year prices and individual beverage consumption quantity patterns available from the NDSHS, following Lewbel (1978).6

Other control variables

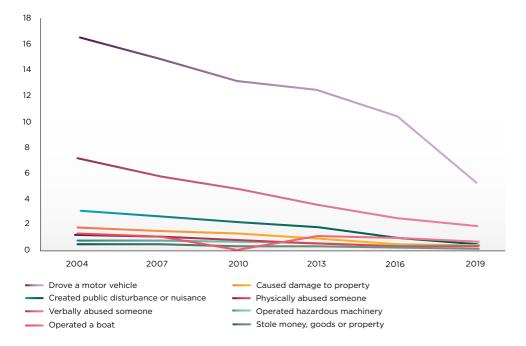
The econometric analysis controls for a range of drinkers' socio-economic, demographic and lifestyle factors available in the survey. In particular, the explanatory variables include individuals' age, gender, marital status, educational attainment, a quadratic specification of (the natural logarithm of) real household income, labour market status, family structure, Indigenous status and whether the individual resides in a capital city. I also include state and year indicators to capture any change in policy or law enforcement, and taste preference.



- ³ In the survey, information on individuals' behaviours when intoxicated is collected via a question asking, 'In the last 12 months, did you undertake the following while under the influence of or affected by alcohol?'. In all surveys prior to 2019, respondents ticked 'Ves' or 'No' for each of the following activities: 'Went to work', 'Went swimming', 'Operated a boat', 'Drove a motor vehicle', 'Operated hazardous machinery', 'Created a public disturbance or nuisance', 'Caused damage to property', 'Stole money, goods or property', 'Verbally abused someone' and 'Physically abused someone'. In the 2019 survey, the questions were structured slightly differently. Here, the options were presented in a list with the instruction to 'select all that apply'.
- ⁴ Owing to interruption in price data collection, AC Nielsen was unable to provide similar price information for the latest two survey years, that is, 2016 and 2019. Using the alcohol CPI available from the Australian Bureau of Statistics (ABS, 2020) as the aggregated trend, I thus extrapolated the specific drink prices in 2013 to their corresponding prices in 2016 and 2019. All prices are converted to Australian dollars of the financial year 2011/12 using the all-items CPI of respondents' respective states of residence, also available from the ABS (2020).
- ⁵ AC Nielsen collect data using the ScanTrack Liquor service that tracks value and volume of sales for off-premise consumption of liquor from supermarkets, grocery/convenience stores and liquor chains (AC Nielsen, 2014).
- ⁶ Note that the use of aggregated price series in the analysis of individual-level data is not uncommon in the literature (for example, Pesko et al., 2016). However, since the prices from AC Nielsen only vary by state and year, they only provide limited variation for identification. To reinforce identification in this study, I employ an approach proposed by Lewbel (1989) and further explored by Hoderlein and Mihaleva (2008) in both parametric and nonparametric settings.

Figure 3.

Sample participation in antisocial behaviours for respondents who had at least an alcoholic drink of any kind in the last 12 months (%).



EMPIRICAL ANALYSIS AND KEY INSIGHTS

Empirical model specification

For practical reasons, I further group the eight antisocial and unlawful behaviours into two broad groups. Given similarities among some of these behaviours, one admissible approach to grouping would be: 1) drink driving (drove a motor vehicle); 2) hazardous, disturbing or abusive behaviours (operated a boat/hazardous machinery; created a public disturbance/ nuisance; caused damage to property; stole money, goods or property; verbally or physically abused someone). To investigate the links between the 10 alcohol beverage types and the two broad groups of antisocial and unlawful behaviour, that is, drinking driving, and hazardous, disturbing, or abusive behaviours, I estimate the causal effect of beverage types respectively for either group of negative behaviour. Specifically, I estimate two sets of 11-equation endogenous multivariate probit (EMVP) models for drink driving and hazardous, disturbing or abusive behaviours, using alcohol beverage prices as instrumental variables to identify the causal effect.7

The estimation of standard errors is clustered at the state level. Since there are only eight states in Australia, to adjust for few cluster biases, I employ the score wild bootstrap proposed by Kline and Santos (2012) for complex nonlinear models using Webb's six-point distribution (Webb, 2014; Cameron and Miller, 2015).

Key insights

The key results of interest, that is the marginal effects (MEs) and their explicit rankings for the two outcomes, are summarised in Table 1. Full estimation results are available upon request. Note that these rankings are based on the magnitudes of the MEs that measure the effects of beverage types on the probability of engaging in each of the two behaviours. They are not rankings for the exact external costs associated with drinking these beverages, as I do not make any assumptions on the actual monetary cost of engaging in these behaviours Nonetheless and importantly. I am able to rank the beverages based on the strength of their association with risky and abusive behaviours.

Beverage preference and drink driving

Focusing on drink driving first, the results in Panel A of Table 1 seem to divide the beverages into two groups. Regularstrength beer, pre-mixed spirits in a can, mid-strength beer, bottled wine, cask wine, and bottled spirits and liqueurs are all associated with a higher probability of drink driving, whilst low-strength beer, pre-mixed spirits in a bottle, fortified wine and other alcoholic drinks are related to negative or insignificant effects on the probability of drink driving. Specifically, in terms of ranking, regular-strength beer has the highest positive impact, and is shown to be linked to a 9.1 percentage-pointhigher probability of drink driving. Bottled wine ranks second for causal effect once observable covariates and endogeneity of beverage choice are both controlled. Interestingly, cask wine and bottled spirits and liqueurs, the drinks that have drawn much attention in the tax debate, while having a positive impact on drink driving, both rank behind mid-strength beer, with a respectively 3.3 and 2.2 percentagepoint higher probability for drink driving. In contrast, low-strength beer and pre-mixed spirits in a bottle are shown to be among the drinks that have the highest association/impacts for reducing the probability for drink driving.

The findings in this study are generally consistent with those of previous studies (Smart, 1996; Rogers and Greenfield, 1999), which find drink driving to be mostly linked to beer and spirits. The study also finds bottled wine to be a significant contributor to drink driving. In addition, unlike previous studies which mostly aggregate all wine types as a homogeneous product, here I use differentiated products. And bottled wine is, in fact, shown to be associated with a higher impact on drink driving than cask wine.

Table 1. Marginal effects and rankings of beverage type on outcome probabilities.

Panel A: Drink driving							
Ranking	Drinks	ME	95% Cl				
1	RSB	0.091***	[0.081, 0.101]				
2	BW	0.055***	[0.046, 0.065]				
3	PMSC	0.038***	[0.026, 0.053]				
4	MSB	0.035***	[0.023, 0.048]				
5	CW	0.033***	[0.021, 0.046]				
6	BS	0.022***	[0.013, 0.032]				
7	FW	0.001	[-0.014, 0.016]				
8	Other	-0.004	[-0.017, 0.008]				
9	PMSB	-0.017**	[-0.030, -0.004]				
10	LSB	-0.018**	[-0.029, -0.007]				

Panel B: Hazardous, disturbing or abusive behaviours							
Ranking	Drinks	ME	95% CI				
1	RSB	0.050***	[0.044, 0.056]				
2	PMSC	0.031***	[0.024, 0.039]				
3	CW	0.029***	[0.020, 0.038]				
4	MSB	0.022***	[0.014, 0.030]				
5	BS	0.014***	[0.009. 0.019]				
6	Other	0.006	[-0.001, 0.014]				
7	PMSB	-0.001	[-0.008, 0.006]				
8	FW	-0.002	[-0.009, 0.005]				
9	BW	-0.003	[-0.008, 0.002]				
10	LSB	-0.027***	[-0.032, -0.021]				

Notes: RSB: regular-strength beer; LSB: low-strength beer; MSB: mid-strength beer; BW: bottled wine; FW: fortified wine; CW: cask wine; PMSC: pre-mixed spirits in a can; PMSB: pre-mixed spirits in a bottle; BS: bottled spirits and liqueurs; Other: other alcoholic drinks. *, ** and *** represent significance at 5%, 1% and 0.1%, respectively.

Beverage preference and hazardous, disturbing or abusive behaviours

Results from Panel B in Table 1 indicate that regular-strength beer, pre-mixed spirits in a can and cask wine are the top three drinks that relate to the highest MEs for increasing the probability of hazardous, disturbing or abusive behaviours. Cask wine currently has the lowest tax on per LAL across all beverages, which has long been the focus of tax reform discussion. The significant association and causal effect of cask wine revealed here (both in relative magnitude and significance) are consistent with Stockwell et al. (1998), and provide a compelling argument for an increase in cask wine tax. The other two beverages that have positive MEs and are ranked the next highest, are bottled spirits and liqueurs and mid-strength beer. Recent data show a growing preference for bottled spirits among young girls (AIHW, 2020). This is also reflected in Figure 2 where we see that bottled spirits and liqueurs are by far the most preferred drinks among adolescent girls.

There is another interesting result to note regards pre-mixed spirits in a bottle. Typically considered a drink preferred by young females, consumption of pre-mixed spirits in a bottle has an insignificant or even a small negative causal effect on hazardous, disturbing or abusive behaviours. Finally, low-strength beer, bottled wine and fortified wine are shown to have negative MEs on the probability of hazardous, disturbing or abusive behaviours, with low-strength beer having the largest negative effect. A noticeable result is for bottled wine. In contrast to the results for drink driving, disturbing or abusive behaviours. Nonetheless, a significantly higher tax per LAL is currently imposed on bottled wine relative to cask wine in Australia.

Heterogeneity by demographic group

To further examine the demographic heterogeneity in the links between alcohol beverage type and negative behaviour, I divide the full sample into five sub-samples and estimate the empirical model for each. These sub-samples are respectively Male, Female, Aged 12-29, Aged 30-49, and Aged 50+. The estimated marginal effects of drink types for each sub-sample are listed in Tables 2 and 3. Compared with results of the overall sample in Table 1. mid-strength beer ranks higher for males while for females it ranks lower in terms of its association with drink driving. The rankings are also slightly different for cask wine, pre-mixed spirits in a can and mid-strength beer among males and females, in terms of their associations with hazardous, disturbing or abusive behaviours. In terms of the differences across age groups, mid-strength beer is more highly ranked in older individuals than in the 12-29 age group, for its association with both drink driving and hazardous, disturbing or abusive behaviours. Bottled spirits and liqueurs also rank higher for the younger age group, with both antisocial behaviours.

However, by and large, across the five sub-samples, results are consistent with those using the full sample. Specifically, regular-strength beer, pre-mixed spirits in a can, bottled wine, cask wine and bottled spirits and liqueurs are associated with a higher probability of drink driving across all sub-samples, whilst low-strength beer, pre-mixed spirits in a bottle and fortified wine have negative or insignificant effects on the probability of drink driving. For hazardous, disturbing or abusive behaviours, regular-strength beer, pre-mixed spirits in a can and cask wine are always among the top-ranked drinks, and bottled spirits and liqueurs is also always a significant contributor. In contrast, low-strength beer, bottled wine and fortified wine are shown to have either negative or insignificant MEs on the probability of hazardous, disturbing or abusive behaviours across all five sub-samples.

^{Ch.} 2 67

CONCLUSION

Alcohol taxation is one of the main policy instruments used by governments around the world to correct for market failures and negative externalities that are associated with excessive alcohol consumption. From an economic perspective, consumers who are rational decision makers should be fully aware of all the benefits and costs associated with alcohol consumption. However, the scale of alcoholrelated harms reported worldwide indicates the existence of serious market failure, and the price mechanism does not necessarily internalise the external cost.

Other than private costs, there are significant external costs related to excessive alcohol consumption that are borne by society. A more conducive approach to alcohol policy, from a societal perspective, is to impose an appropriate amount of tax to any such consumption based on the negative externalities it generates. This chapter examines the link between alcohol beverage types and risky and abusive behaviours, in order to contribute to the discussion on alcohol policy interventions from an economic perspective. Since it is less feasible to tax heterogeneous consumers, taxing the products that are more likely to be associated with negative external costs appears to be a more feasible and efficient approach. By quantifying the link between individuals' risky behaviours and the types of alcohol beverages they mostly consume, this chapter provides not only evidence to support the case for taxing alcohol, but also some potential empirical justification for differentiated volumetric tax rates by beverage type.

The empirical analysis reveals that, broadly speaking, regularstrength beer and pre-mixed spirits in a can rank the highest in their links to higher probabilities of both drink driving and hazardous, disturbing or abusive behaviours. Next in the ranking are mid-strength beer, cask wine, and bottled spirits and liqueurs, which are also linked to higher probabilities of drink driving and hazardous, disturbing or abusive behaviours. In contrast, lowstrength beer and fortified wine are linked to lower probabilities of drink driving and hazardous, disturbing or abusive behaviours.

Our disaggregated beverage study also reveals some other interesting findings. A noticeable result is for bottled wine. Whilst bottled wine is linked to a moderate but positive effect on drink driving, it is also linked to a significantly lower probability of hazardous, disturbing or abusive behaviours. Another interesting drink is pre-mixed spirits in a bottle, as this beverage is typically consumed by young females. However, once observable demographic factors such as gender and age, and endogeneity of beverage choice are controlled for, pre-mixed spirits in a bottle has a negative causal effect on hazardous, disturbing or abusive behaviours.

The rankings for beverage types by links to negative behaviours seem to depart markedly from the ranking of their current per LAL tax. For instance, of all harmful beverage types, cask wine appears to be significantly under-taxed despite its external costs to society. It is also important to note that the external costs of regular- and mid-strength beer are at least as high as those of pre-mixed drinks and yet there is a significant disparity across their tax rates.⁸ Finally, whilst currently having the lowest per LAL tax among all drinks, there is evidence that cask wine is ranked among the highest for its association with hazardous, disturbing or abusive behaviours.

The current Australian alcohol tax system is complex, anomalous and incoherent, and there is a great need for reform and simplification. In response to similar concerns, the UK government began an alcohol tax review in 2020 and has since produced a proposal for a simpler volumetric tax system that is more consistent across beverages but with a progressive structure so that lower alcohol concentration products pay a lower duty rate (HM Treasury, 2021). This study contributes to the discussion on fairness and economic rationality in alcohol tax reform from a unique angle. It provides important empirical evidence linking alcohol beverage types to negative externalities. The main aim is to show that the same amount of alcohol sold in different alcohol beverage types is linked to different probabilities of harmful behaviours and thus different magnitudes of negative externalities. The findings will thus allow policy-makers to develop policies that can target alcoholic drinks that are more harmful in order to achieve the highest efficiency at the societal level.

Although this study directly informs the alcohol tax reform debate, it cannot suggest the exact amounts of tax for different beverages, as estimating the monetary costs for different alcoholrelated behaviours, or separating private and public costs, are beyond its scope. However, the empirical analysis offers sufficient evidence to show that the same amount of alcohol in different beverage forms is not associated with equal harm, and argues against a prominent proposal of 'equal tax for equal alcohol' in the tax reform debate. The design and full evaluation of the impacts of any proposed tax changes, which would need information on the substitution effects across beverages in consumer demand, is also beyond the scope of the current study.

³ According to the Australian Taxation Office (2021), regular (greater than 3.5% Alc/Vol) and mid (3% to 3.5% Alc/Vol) strength beer are taxed at \$52.49 per LAL. In contrast, pre-mixed spirits drinks are taxed at \$88.91 per LAL.

Ranking	Drink	ME	95% Cl	Drink	ME	95% CI		
	MALE							
		Drink dri	ving	Hazardous, disturbing or abusive behaviours				
1	RSB	0.123***	[0.110, 0.136]	RSB	0.061***	[0.054, 0.069]		
2	MSB	0.072***	[0.053, 0.091]	PMSC	0.039***	[0.026, 0.052]		
3	BW	0.065***	[0.049, 0.080]	CW	0.028***	[0.015, 0.044]		
4	PMSC	0.033**	[0.010, 0.056]	MSB	0.021***	[0.010, 0.033]		
5	BS	0.030***	[0.014, 0.047]	BS	0.019***	[0.010, 0.029]		
6	CW	0.020*	[0.001, 0.042]	Other	0.004	[-0.009, 0.017]		
7	FW	0.012	[-0.013, 0.037]	PMSB	0.000	[-0.015, 0.016]		
8	Other	-0.017	[-0.041, 0.009]	FW	-0.007	[-0.019, 0.006]		
9	PMSB	-0.036*	[-0.062, -0.007]	BW	-0.013**	[-0.022, -0.003]		
10	LSB	-0.040***	[-0.058, -0.023]	LSB	-0.037***	[-0.045, -0.028]		

FEMALE

		Drink dri	iving	Hazardous, disturbing or abusive behaviours		
1	RSB	0.059***	[0.043, 0.074]	RSB	0.042***	[0.034, 0.052]
2	BW	0.046***	[0.038, 0.056]	CW	0.032***	[0.022, 0.043]
3	PMSC	0.044***	[0.030, 0.060]	PMSC	0.026***	[0.018, 0.035]
4	CW	0.037***	[0.022, 0.052]	MSB	0.011*	[0.001, 0.022]
5	BS	0.023***	[0.013, 0.033]	BS	0.008**	[0.002, 0.013]
6	MSB	0.022**	[0.004, 0.040]	Other	-0.001	[-0.007, 0.007]
7	FW	0.000	[-0.015, 0.015]	BW	-0.001	[-0.007, 0.005]
8	LSB	-0.008	[-0.022, 0.010]	PMSB	-0.004	[-0.010, 0.002]
9	Other	-0.010	[-0.022, 0.002]	FW	-0.009*	[-0.017, -0.001]
10	PMSB	-0.016**	[-0.028, -0.005]	LSB	-0.018***	[-0.024, -0.011]

Notes: RSB: regular-strength beer; LSB: low-strength beer; MSB: mid-strength beer; BW: bottled wine; FW: fortified wine; CW: cask wine; PMSC: pre-mixed spirits in a can; PMSB: pre-mixed spirits in a bottle; BS: bottled spirits and liqueurs; Other: other alcoholic drinks. *, ** and **** denote significance at 5%, 1% and 0.1%, respectively.

Table 3.Marginal effects on outcome probabilities by sub-sample.

		Aged							
		-	Aged 12-29						
	Drink driving		Hazardous, disturbing or abusive behaviours						
RSB 0.	129***	[0.100, 0.156]	RSB	0.127***	[0.102, 0.155]				
CW 0	.070*	[0.009, 0.134]	BS	0.068***	[0.042, 0.093]				
BS 0.0	065*** [[0.040, 0.092]	PMSC	0.053***	[0.030, 0.079]				
BW 0.	054**	[0.020, 0.087]	CW	0.051*	[0.010, 0.093]				
PMSC 0.0	049***	[0.024, 0.077]	Other	0.014	[-0.020, 0.046]				
FW C	0.042	[-0.029, 0.132]	PMSB	0.007	[-0.022, 0.037]				
Other C).039 [-0.004, 0.084]	MSB	-0.001	[-0.026, 0.026]				
MSB C).037 [-0.003, 0.077]	FW	-0.017	[-0.051, 0.023]				
LSB -(0.012 [-0.054, 0.035]	BW	-0.033*	[-0.059, -0.008]				
PMSB -(0.022	-0.052, 0.009]	LSB	-0.067***	[-0.095, -0.037]				
	CW 0 BS 0.0 BW 0. PMSC 0.0 FW C Dther C MSB C LSB -	RSB 0.129*** CW 0.070* BS 0.065*** BW 0.054** PMSC 0.049*** FW 0.042 Dther 0.039 LSB -0.012	RSB 0.129*** [0.100, 0.156] CW 0.070* [0.009, 0.134] BS 0.065*** [0.040, 0.092] BW 0.054** [0.020, 0.087] PMSC 0.049*** [0.024, 0.077] FW 0.042 [-0.029, 0.132] Dther 0.039 [-0.004, 0.084] MSB 0.037 [-0.054, 0.035]	RSB 0.129*** [0.100, 0.156] RSB CW 0.070* [0.009, 0.134] BS BS 0.065*** [0.040, 0.092] PMSC BW 0.054** [0.020, 0.087] CW PMSC 0.049*** [0.024, 0.077] Other FW 0.042 [-0.029, 0.132] PMSB Other 0.039 [-0.004, 0.084] MSB MSB 0.037 [-0.003, 0.077] FW LSB -0.012 [-0.054, 0.035] BW	RSB 0.129*** [0.100, 0.156] RSB 0.127*** CW 0.070* [0.009, 0.134] BS 0.068*** BS 0.065*** [0.040, 0.092] PMSC 0.053*** BW 0.054** [0.020, 0.087] CW 0.051* PMSC 0.049*** [0.024, 0.077] Other 0.014 FW 0.042 [-0.029, 0.132] PMSB 0.007 Other 0.039 [-0.004, 0.084] MSB -0.001 MSB 0.037 [-0.003, 0.077] FW -0.017 LSB -0.012 [-0.054, 0.035] BW -0.033*				

Aged 30-49

		Drink dri	ving	Hazardous, disturbing or abusive behaviours		
1	RSB	0.103***	[0.087, 0.122]	RSB	0.058***	[0.048, 0.068]
2	BW	0.061***	[0.046, 0.076]	CW	0.054***	[0.036, 0.074]
3	PMSC	0.057***	[0.035, 0.082]	PMSC	0.038***	[0.027, 0.051]
4	CW	0.054***	[0.029, 0.081]	MSB	0.034***	[0.021, 0.046]
5	MSB	0.039***	[0.017, 0.062]	Other	0.019**	[0.005, 0.032]
6	Other	0.039***	[0.013, 0.068]	BS	0.013**	[0.004, 0.022]
7	BS	0.021**	[0.005, 0.038]	BW	0.001	[-0.009, 0.009]
8	FW	0.004	[-0.023, 0.030]	FW	-0.005	[-0.017, 0.008]
9	LSB	-0.022	[-0.042, 0.001]	PMSB	-0.013*	[-0.023, -0.003]
10	PMSB	-0.023*	[-0.045, 0.000]	LSB	-0.031***	[-0.040, -0.021]

Aged 50+

		Drink dri	ving	Hazardous, disturbing or abusive behaviours		
1	RSB	0.080***	[0.067, 0.094]	RSB	0.029***	[0.023, 0.036]
2	MSB	0.042***	[0.026, 0.058]	PMSC	0.014**	[0.004, 0.026]
3	BW	0.040***	[0.030, 0.050]	MSB	0.011***	[0.005, 0.018]
4	PMSC	0.035**	[0.012, 0.062]	CW	0.010***	[0.005, 0.017]
5	CW	0.020***	[0.008, 0.035]	BS	0.006**	[0.002, 0.011]
6	BS	0.014***	[0.004, 0.027]	PMSB	0.003	[-0.005, 0.015]
7	FW	0.003	[-0.012, 0.018]	Other	-0.001	[-0.007, 0.006]
8	Other	-0.003	[-0.020, 0.015]	FW	-0.001	[-0.006, 0.004]
9	PMSB	-0.006	[-0.026, 0.018]	BW	-0.002	[-0.007, 0.002]
10	LSB	-0.011	[-0.023, 0.001]	LSB	-0.009***	[-0.013, -0.004]

Notes: RSB: regular-strength beer; LSB: low-strength beer; MSB: mid-strength beer; BW: bottled wine; FW: fortified wine; CW: cask wine; PMSC: pre-mixed spirits in a can; PMSB: pre-mixed spirits in a bottle; BS: bottled spirits and liqueurs; Other: other alcoholic drinks. Standard errors are given in parentheses. *, ** and *** represent significance at 5%, 1% and 0.1%, respectively. 95% confidence intervals are clustered at the state level and generated by the score wild bootstrap using Webb's (2014) six-point distribution.

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