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Invited Review

Pricing as a means of controlling alcohol consumption

Anurag Sharma[†,‡,*], Kompal Sinha[§], and Brian Vandenberg[‡]

[†]School of Public Health and Community Medicine, University of New South Wales, Kensington, NSW 2052, Australia, [‡]Centre for Health Economics, Monash University, Clayton, VIC 3800, Australia, and [§]Department of Economics, Macquarie University, Eastern Rd, North Ryde, NSW 2109, Australia

*Correspondence address. Rm 238, Level 2, Samuels Building (F25), School of Public Health & Community Medicine, University of New South Wales, Kensington 2052, Australia. E-mail: anurag.sharma@unsw.edu.au

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Abstract

Background: Reducing the affordability of alcohol, by increasing its price, is the most effective strategy for controlling alcohol consumption and reducing harm.

Sources of data: We review meta-analyses and systematic reviews of alcohol tax/price effects from the past decade, and recent evaluations of tax/price policies in the UK, Canada and Australia.

Areas of agreement: While the magnitudes of price effects vary by subgroup and alcoholic beverage type, it has been consistently shown that price increases lead to reductions in alcohol consumption.

Areas of controversy: There remains, however, a lack of consensus on the most appropriate taxation and pricing policy in many countries because of concerns about effects by different consumption level and income level and disagreement on policy design between parts of the alcoholic beverage industries.

Growing points: Recent developments in the research highlight the importance of obtaining accurate alcohol price data, reducing bias in estimating price responsiveness, and examining the impact on the heaviest drinkers.

Areas timely for developing research: There is a need for further research focusing on the substitution effects of taxation and pricing policies, estimation of the true tax pass-through rates, and empirical analysis of the

supply-side response (from alcohol producers and retailers) to various alcohol pricing strategies.

Key words: alcohol taxation, price elasticity, minimum unit pricing

Background

Harmful use of alcohol results in 3.3 million deaths worldwide each year and represents 5.1% of the global burden of disease.[1] While there is not a singular determinant of this burden, it is widely recognized that alcohol has never before been as accessible, available and affordable as it is throughout the world today.[2] A large body of scientific research has established that reducing the affordability of alcohol (by increasing its price) is the most effective and least costly strategy for controlling alcohol consumption and reducing the associated health harms.[3,4] Accordingly, the World Health Organization (WHO) recommends that governments should implement taxation and pricing policies which increase the relative cost of alcohol as an essential part of a comprehensive public health response to alcohol-related harm.[5]

In recent years, interest among policy makers in alcohol pricing controls as tools for reducing harm has intensified. In Canada, the extent of implementation and the health effects of decades old policies that regulate minimum prices for alcohol are now well documented.[6–11] The great appeal of these policies from a public health perspective is that they reduce the availability of the cheapest alcohol often favoured by the heaviest drinkers.[6] Importantly, several Canadian provinces set minimum prices based on the alcohol content of the product, thereby discouraging consumption of higher-strength products while encouraging consumption of lower-strength products.[6] Similar policies have been implemented in a small number of other countries, such as Russia for example, where a minimum price for vodka was introduced in 2010.[12] Legislation has also recently been passed in Scotland to implement a 50p per unit minimum price on alcohol, though it has not yet been applied due to a legal challenge led by the Scotch Whisky Association.[13] In some US states, such as Kansas and Ohio, governments have set minimum mark-ups or profit margins for wholesalers and retailers of alcohol, which effectively establishes a minimum price.[14] Around the world, many governments are also continuing to use traditional alcohol tax systems to increase the price of alcohol. For example, in 2015, the government of Belgium increased taxes on beer, wine and spirits by 8%, 31% and 41%, respectively.[15] Across Eastern Europe, the negative health and social consequences of alcohol have already reached epidemic proportions,[1] and in other parts of the world, particularly China, the worst may be yet to come as consumption levels begin to rise, while adequate taxation and pricing policies lag well behind.[16]

The prevalence of drinking, patterns of use, and rates of alcohol-related harm in the population are shaped by a mix of micro and macro-level determinants such as the age and sex of individual drinkers, the historical, religious and cultural place of alcohol in society, and 'upstream' modifiable factors such as the affordability, availability and marketing of alcohol and the policy and regulatory context (see Fig. 1). A public health approach draws attention to these upstream sources of problems, and the upstream solutions, rather than concentrating exclusively on the individual behaviour of the drinker. A focus on role of prices is an especially important part of this approach because prices can be directly modified through government policy intervention and can effectively change both total population and individual drinking behaviour. Taxing alcoholic beverages according to alcohol (ethanol) content (known as volumetric taxation), the beverage size, or its value, is the most commonly applied policy intervention designed to alter prices.[5] However, the extent of the price change depends not only on the method and rate of

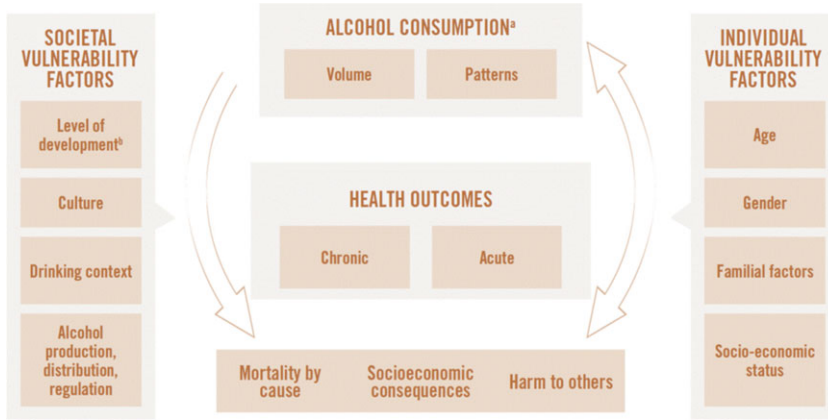

Fig. 1 Conceptual causal model of alcohol consumption and health outcomes. (**a**) Quality of the alcohol consumed can also be a factor. (**b**) Development of health and welfare system, and economy as a whole. The figure is based on references [17,18] and originally appears in reference [5]. Reproduced with permission.

taxation, but also the extent to which the full cost of the tax is passed-through to real prices faced by consumers.[4] The effect of taxes on real prices also depends on whether tax rates are adjusted over time with inflation.[4]

Taxes can represent a substantial component of the price of alcoholic beverages. However, production costs, tax rates and retail prices often vary considerably between alcohol beverage categories, resulting in large price differences between beverage categories regardless of their alcohol content and propensity to cause harm.[2] While this is the reality of free-market competition in many countries, in some jurisdictions there are policy controls that regulate the minimum retail price of alcohol. For example, in all Canadian provinces, except for Alberta, government controls off-premises sales of at least one type of alcoholic beverage, and under these arrangements it is therefore able to regulate the floor price beneath which products may not be sold.[6] Nordic countries (Finland, Iceland, Norway and Sweden), several US states and a number of Indian states also operate partial state monopolies on the sale of alcohol.[2]

This review summarizes the findings of recent meta-analyses and systematic reviews on the estimated effect of taxes and prices on alcohol consumption published over the past decade. Combined, these include more than 1000 estimates from more than 200 studies. We also draw upon recent examples of alcohol tax/pricing policy evaluations from the UK, Canada and Australia, noting that these represent a small, albeit important, selection from the large body of international literature. We focus on the UK, Canada and Australia because they are jurisdictions where minimum pricing policies have received considerable political and research attention in recent years. We highlight some areas of controversy and methodological developments in the empirical research and suggest specific areas for timely and policy relevant research.

Areas of agreement

Alcohol consumption reduces with an increase in its price

The empirical literature has consistently found that increasing the price of alcohol leads to a reduction in consumption.[4,19–21] The magnitude of reduction is captured by price elasticity of demand: the change in consumption of alcohol as a result of a unit change in its price, keeping all other factors (e.g. income, prices of other products) constant. Accurate estimates of price elasticities represent a critical input for the design of alcohol taxation and

pricing policies, because they indicate how much prices must increase in order to achieve the intended reduction in consumption.[4] Meta-analyses and reviews of estimates from a large body of international empirical research show that a one per cent increase in the price of alcohol will, on average, reduce demand for alcohol by around half of one per cent (see Table 1). The magnitude of elasticity differs for different population groups, but its sign is always negative. Meta-analyses show that price increases are slightly less effective at reducing drinking among young people compared with the general population, and male drinkers are slightly less responsive than female drinkers to price increases.[19] Despite a perception that the heaviest drinkers may not be affected by tax and price increases, Wagenaar's meta analysis of estimates from 10 studies found that, overall, heavy drinkers are price responsive, albeit less than the general population, with a mean price elasticity of demand of −0.28.[21] However, other reviews of research findings in this area obtain mixed results, with Nelson's recent review finding that only two of the 19 studies he includes show heavy-drinking adults to be significantly and substantially responsive to prices.[22]

Response to price varies by beverage type

The evidence from several meta-analyses suggests that beer has the most inelastic demand (i.e. is the least responsive to price changes) among different types of alcoholic beverages, with an average own-price elasticity close to −0.3. This reflects that beer is almost treated as a staple 'food' in populations where most published estimates have been derived.[2] On the other hand, the estimated own-price elasticities of demand for wine and spirits are relatively larger (around −0.7), indicating greater responsiveness to price changes compared to beer. The estimated price elasticity of demand for ready-to-drink (RTD) spirits is generally similar to that for all spirits.[23,26] The price elasticity of alcohol may also vary depending on the place of purchase, with studies showing alcohol purchased off-trade (i.e. consumed away from the licensed premises) is more price-responsive than alcohol purchased on-trade (i.e. purchased and consumed within a pub, bar, restaurant).[26,27]

In summary, the empirical evidence consistently shows that an increase in the price of alcohol leads to a reduction in the quantity consumed, and this effect holds for different population groups, different categories of alcohol, and for off-trade and on-trade purchases.[19–21,26] The magnitude of reduction, however, differs considerably.

Areas of controversy

Lack of consensus on the most appropriate taxation and pricing policy

Globally, it is well established that increasing the price of alcohol is an essential strategy for reducing alcohol consumption and harm, and more than 90% of countries impose some form of taxation on alcohol.[1] Yet, in practice, there remain considerable

Table 1 Estimated own-price elasticity of demand for alcohol: findings from meta-analyses and reviews of international estimates

	Total alcohol	Beer	Wine	Spirits
Collis *et al.* (UK only)[23]		−0.40	−0.86	−0.72
Elder *et al.*[4]	−0.77	−0.50	−0.64	−0.79
Fogarty[20]		−0.33	−0.55	−0.76
Gallet[19]	−0.50	−0.36	−0.70	−0.68
Rabinovich *et al.*[24]	−0.32			
Ruhm *et al.*[25]	−0.30			
Wagenaar *et al.*[21]	−0.51	−0.46	−0.69	−0.80

Notes: Values shown are mean estimates, if available from the published source. Otherwise, median estimates are shown.

disagreements on the most appropriate taxation or pricing policy to apply in different contexts, and hence policy implementation is uneven around the world. In countries such as England and Australia, for example, much of the disagreement originates from concerns about the potential for disproportionate increases in the financial burden of taxation and pricing policies on the lightest drinkers, whose consumption is considered to pose relatively small individual health risks and negative externalities to society compared with the heaviest drinkers.[28,29] In addition, concerns are raised that any increases in financial burden from higher taxes and pricing policies may be borne disproportionately by poor households.[30–32]

Despite the potential revenue gains for government from higher alcohol taxes, officials are often reluctant to raise alcohol taxes fearing increased illicit alcohol production, cross-border smuggling and substitution to more harmful alternative substances when the relative price of alcohol increases.[32] A minimum unit price policy is seen to potentially have additional downsides. For example, in countries without government monopolies on sales, there is a possibility of losing revenue to alcohol producers and retailers because the profit margins on some of the cheapest products will increase when prices are inflated to the minimum level. However, UK studies estimate that, overall, minimum unit pricing policies will be revenue neutral because there will be some increases in sales tax revenues (e.g. Value Added Tax (VAT) applied to the new minimum prices), which will offset most losses in alcohol tax revenues from the reductions in overall consumption.[33]

There is also disagreement and division within the alcoholic beverage industries on the most appropriate taxation and pricing policy arrangements, with the sectors that perceive they will be most adversely affected (e.g. producers and retailers of cheap alcohol) expressing more opposition to particular taxation and pricing policies than others.[34] These divisions can be heightened where there is a history of government policy favouring one beverage category over another with tax concessions (e.g. the relatively low tax on wine in southern European countries), and where specific categories are taxed higher because of a perception of greater health risks (e.g. the relatively high tax on youth-oriented 'alcopops' in Australia and Germany). A further obstacle to policy change in many countries is the low level of support among voters and politicians for increasing alcohol taxes/prices.[2]

Differential policy effects by consumption level

There is a growing literature addressing the differential impacts of various taxation and pricing policies by consumption level. A modelling study using data on alcohol expenditure by households in England found that a 10% general price increase would be similarly effective as a £0.45 per unit (10 ml ethanol) minimum price policy in reducing consumption, health-care costs, and health-related quality of life losses in all population subgroups.[33] However, the minimum price policy would achieve these health improvements with much lower costs imposed on the lightest drinkers (£8.70 per person per year) compared to a general price increase (£17.10). A related UK modelling study of how various pricing policy options would impact consumers reported similar findings, showing that a minimum price of £0.50 per unit would lead to a small cost increase for the lightest drinkers (£12 per drinker per year) compared to the heaviest drinkers (£163).[28] Furthermore, the reductions in consumption would be greatest among the heaviest drinkers (−10%) compared to the lightest drinkers (−4%). An Australian study estimated that, despite the concerns mentioned above, neither a minimum unit price policy (A$1 per standard drink) (12.67 ml ethanol) nor a uniform volumetric tax on beer and wine (A$42 per litre of alcohol) will have a large impact on the annual costs for the lightest drinkers.[35] However, these policies will lead to increased costs for the heaviest consumers, and importantly, a substantial reduction in their estimated purchase volumes. These studies suggest that strategies that increase the cost of the cheapest alcohol, which is favoured by the heaviest drinkers, are likely to be the most effective policy options for reducing heavy drinking levels and harm without 'unfairly' impacting on the lightest drinkers. Furthermore, the emerging

research indicates that despite the addictive nature of alcohol, there is evidence that the heaviest consumers do respond to price changes. A study which examined the potential effects of implementing a A$2 minimum unit price across the entire distribution (quantiles) of alcohol purchases found that price responsiveness is significant even at the high end of the distribution (i.e. estimated price elasticity of −0.16 at the 97th percentile of alcohol purchase), translating to large reductions in the estimated volume of alcohol purchased (−0.9 standard drinks per day).[29]

Differential policy effects by income level

The consistent finding in the above studies, that the heaviest consumers are likely to be the most affected by policies that increase the price of cheap alcohol, has a direct implication for how these policies impact across income groups. A study that modelled the likely impact of a £0.45 minimum unit price policy across consumers of different incomes and drinking levels in England found that irrespective of income, the impact of the policy on the lightest drinkers was negligible.[36] However, there would be a substantial impact on the heaviest drinkers, and especially for those on low incomes, as this group purchase more alcohol at less than the minimum unit price threshold compared with other groups. Offsetting these burdens on low-income heavy drinkers, however, is the substantial reduction in the estimated volume of consumption by these drinkers and the subsequent health gains in terms of reductions in alcohol-related morbidity and mortality. This highlights the importance of weighing up both the likely financial burdens and the health gains of pricing policies when assessing their impact on the poorest consumers. Another UK study which compared the impacts of different alcohol taxation and pricing policies for socioeconomic groups found that volumetric taxation and a minimum unit price policy outperform both a value-based tax or an increase in current taxes in reducing health inequalities.[37] Importantly, they find that the two better performing policies would target heavy drinking without penalizing people with low incomes who consume alcohol lightly. A study of the effects of current and alternative alcohol taxation and pricing policies in Australia shows that existing alcohol taxes do not disproportionately impact on the lowest income consumers, and that the financial and behavioural impacts of alternative policies for this group are mostly small and concentrated among the heaviest drinkers.[38] Overall, they show that policies that increase the cost of the cheapest alcohol, such as a minimum unit price, can be effective in reducing alcohol consumption, without having highly regressive effects. Here, regressive means an increase in costs that is higher as a proportion of income for the poorest households compared with the wealthiest.

Recent developments

There have been two important developments recently in research on the price elasticity of demand for alcohol: obtaining quality price data; and, controlling for the confounding nature of price when estimating elasticities.

Obtaining accurate alcohol price data

A critical issue in studies that estimate the elasticity of demand for alcohol is the quality of the price variable, which can vary due to difficulties in measuring and defining alcohol prices. For example, one way of defining price is to use self-reported surveys where individuals recall the quantity of alcohol consumed and total expenditure on alcohol in past 2 weeks. Here, the price paid is calculated as a unit value, by dividing total expenditure by quantity. However, such a proxy measure of price is likely to suffer from measurement error and reporting bias, and any demand elasticities derived from such variables can be misleading. Several studies based on US data use the Cost of Living Index (COLI) data that reports prices of beer, wine and whisky from 120 to 300 large and medium cities in the US. However, these prices are also likely to suffer from measurement error and contribute to bias is elasticity estimates as they are collected for a single brand and do not capture the variation in 'quality'

of alcohol consumed. Ruhm *et al.* estimate and compare demand elasticities using alternative measures of the price of alcohol and suggests that price information obtained from scanner data is the most suitable to accurately calculate price elasticity.[25]

A number of recent empirical studies have moved in this direction, using scanner data to estimate the price elasticity of alcohol. Scanner data typically includes a unique level of fine detail on individual household alcohol purchases that is not provided in other publicly available population survey datasets, such as the type of alcohol purchased, brand, quantity, size, flavour, the price paid, and whether it has been purchased as a multi-pack. Scanner data is routinely collected by market research companies, such as the ACNielsen Company, for example, who maintain a large panel of household shoppers that are given a barcode scanning device to scan all food and beverage items they purchase from supermarkets or other retail outlets. The main advantage of this data is its accuracy. A validation study of scanner data in the USA found that households reported single purchases 99% accurately and multiple purchases 86% accurately (when checked against stores' sales records).[39] Ruhm *et al.* show that elasticity estimates are sensitive to the source of price data, and that demand elasticities calculated using price information obtained from scanner data is relatively lower than those estimated using other data sources.[25] However, it should be noted that, usually, this data provides information exclusively about off-trade alcohol purchases, which is only part of total alcohol purchases in the population. Another potential limitation of scanner data is that the purchaser may not be the consumer of the alcohol, or may inaccurately record purchases. There may also be bias in the scanner survey enrolment (see Appendix in Sharma *et al.* for more details[29]).

Reducing bias in estimates of alcohol elasticity

The use of alcohol prices from scanner data has also led to changes in the methodologies used to estimate elasticity, as these prices may be confounding or endogenous, which can bias the elasticity estimates. Bias can arise because some variation in prices reported in scanner data may be due to the characteristics of individuals who purchase alcohol. For example, the same brand of alcohol sold in stores located in higher socioeconomic areas is likely to be relatively more expensive because the willingness to pay by shoppers in these areas is expected to be higher. Similarly, large family households who buy multi-packs may pay lower prices for the same brand of alcohol compared to single person households who purchase an individual product only. Thus, some of the variation in the price of alcohol purchased is due to household characteristics and preferences, and ignoring this might lead to finding a misleading relationship between the price and quantity demanded (elasticity) of alcohol. A recent study by Sharma *et al.* controlled for this endogeneity using an area level price index (generated from scanner data prices) and found that ignoring endogeneity of prices overestimates the elasticity of alcohol.[29]

Interpreting elasticity values

The low average size of price elasticity values for alcohol often gives the impression that an increase in price will lead to very modest decrease in alcohol consumption. However, given that pricing policies are primarily targeted towards very heavy and addictive drinkers with high levels of consumption, the actual magnitude of reductions in consumption and associated health gains can be significant. This is because even though the lightest and heaviest drinkers may respond to price changes at similar proportions, the change will be much greater for the heaviest drinkers in terms of alcohol volume. The effects are also likely to reflect important differences between lightest and heaviest drinkers in terms of drinking location and product preferences. For example, the study by Sharma *et al.* using scanner data and controlling for endogeneity in prices found that implementing a $2 MUP policy will lead to a modest percentage reduction of around −17% in alcohol off-premises purchase volumes.[29] However, while this percentage change translates to a small magnitude of alcohol for the lightest

drinkers, for heavy drinkers it amounts to a per capita reduction of almost 1 standard drink per day. Thus, research is increasingly recognizing the importance of showing how alcohol pricing policies can target the heaviest alcohol consumers, particularly those who purchase large volumes of very cheap alcohol. For example, applying a A$1 per standard drink MUP policy to cheap bulk wine in Australia, which currently costs around A$0.33 per standard drink, would lead to a 300% price increase and, combined with the estimated price elasticity of alcohol, would result in significant reductions in alcohol consumption and potentially deliver considerable health gains to society.[35] Empirical studies consistently show that increasing the price of particular alcohol products that are known to be associated with harmful drinking patterns can reduce alcohol problems in the population. For example, a study of the effect of a one-off 70% increase in the tax on 'alcopops' in Australia in 2008 found that the tax increase was associated with a reduction in rates of alcohol related harm among males aged 19 years and younger.[40]

Areas timely for developing research

The existing literature has mostly focussed on own-price elasticity of alcohol. However, there is a possibility that while an increase in the price of spirits, for example, will reduce consumption of spirits, it may also result in consumers switching preferences towards substitutes, such as beer for example, and thereby increase consumption. Such behaviour is captured by the cross-price elasticity of demand for alcohol. That is, the impact of an increase in the price of spirits upon the consumption of beer, for example. The total price effect will then be a combination of these two effects (own- and cross-price elasticities), and an increase in beer consumption will offset to some extent the decrease in spirits consumption. Such information is imperative to analyse the full impact of any taxation strategy or pricing policy. However, at present there is very limited evidence on cross-price elasticity. While some studies indicate that cross-price elasticties are mostly small and/or insignificant,[26] and that most substitution is only significant between on- and off-trade alcohol of the same type,[27] there remains considerable scope for further research in this area, requiring good quality data on alcohol prices, purchasing and consumption.

Another effect of taxation strategies and pricing policies, which is related to the total price effect, is the income effect. An increase in the price of alcohol reduces the real income of the household and thus can affect their alcohol consumption, the magnitude of which depends on the 'income' elasticity of alcohol. The empirical literature on income effects is relatively sparse compared to the large body of research on price effects. In particular, there is a need for estimates of income elasticity for heavy drinkers, as elasticity estimates at the sample average only are not sufficiently detailed to inform policy. Ideally, estimates of the income effect of taxation and pricing policies should be calculated across the entire distribution (quantiles) of alcohol consumption.

Most modelling studies of alcohol taxation and pricing policy changes assume a 100% tax pass-through rate. That is, they assume that the full value of the tax increase will be passed on to consumers by the producers and retailers. However this might not always occur, as it depends on the competitive structure of the market.[24,41] This gap in the literature needs to be filled by research which formally analyses supply side responses to alcoholic taxation and pricing policy changes.

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Conflict of interest statement

None.

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