Modelling the impact of a minimum unit price (MUP) on alcohol consumption in the Western Cape

Professor Corné Van Walbeek and Naomi Gibbs

August 2021

CONTENTS

ACKNOWLEDGEMENTS

The authors wish to thank Prof Richard Matzopoulos, Dr Annibale Cois and Dr Grieve Chelwa for their contributions in the drafting of this reported. We also thank Mr Colin Angus from the University of Sheffield, Prof Charles Parry, Dr Laurine Platzky and Stephen Harrison for reviewing the report, Dr Nadine Harker for compilation and Ms Elizabeth Baldwin for editing.

EXECUTIVE SUMMARY

Introduction

Alcohol harm in South Africa, and in the Western Cape Province, is significant and far-reaching. One policy which has the potential to reduce that burden is Minimum Unit Pricing (MUP), whereby a retail price floor is set which depends upon the alcohol content of the drink. This policy impacts the cheapest alcohol, which is preferred by the heaviest drinkers, and therefore is a targeted policy for alcohol harm reduction. An MUP applies regardless of drink type and therefore prevents the consumer being able to switch to alternative forms of cheap alcohol.

International evidence, particularly from Scotland and Australia, indicates that MUP is an effective policy for reducing alcohol consumption and harm (Public Health Scotland, 2020, Taylor et al., 2021, Laslett et al., 2021). Recently published modelling studies, based on South African data, indicate that an MUP policy would reduce consumption and associated health harm (Van Walbeek and Chelwa, 2021, Gibbs et al., 2021). The first model, which we will call the University of Cape Town (UCT) model, focuses purely on the economic implications of a possible MUP, whereas the second model, the Sheffield model, focuses primarily on the epidemiological impact of an MUP. As part of a broader scheme of work funded by the DG Murray Trust on behalf of the Western Cape Provincial government, these national MUP quantitative models, published in academic journals, have been adjusted by the authors (and a consortium of experts) to produce new estimates tailored to the Western Cape Province.

MUP impact on consumption: The University of Cape Town (UCT) Model

In this report the UCT model projected the impact of a provincial MUP on consumption. It used 2014 National Income Dynamic Study (NIDS) data to estimate both consumption and prices, categorising households into one of four types: moderate drinkers, intermediate drinkers, occasional binge drinkers, and heavy drinkers. The NIDS data was also used to calculate price elasticities, which estimate how drinkers' consumption would reduce when faced with a price increase.

The model for the Western Cape indicates the likely decrease in alcohol consumption across the four drinker types for different levels of the MUP, and for total alcohol consumption. The model considers various levels of the MUP (between R2 and R15 per unit), and the associated predicted decrease in consumption across these four drinker types. For example, the analysis indicates that a province-specific MUP of R8 per unit (i.e. 15 ml (or 12 g) of pure ethanol) would reduce consumption by 11.5%, but with a high degree of variation between drinker groups. Regular heavy drinkers are the most impacted by the policy as they indicate in the surveys that they drink the cheapest alcohol. Despite the fact that moderate drinkers are more price sensitive than heavy drinkers, they are the least affected by an MUP,

because a substantial proportion of the alcohol they consume is purchased at prices above the MUP level.

Alcohol related excise taxes and VAT are collected by the national government; provincial governments do not exercise this authority. We estimated the percentage of total government excise tax revenue and VAT revenue that is attributable to alcohol sales in the Western Cape. The model estimates that, should an MUP be implemented in the Western Cape, the changes in government revenue (from alcohol-related taxes generated in the Western Cape) will be small. If the MUP is set at a low level (below R10), it may result in a slight decrease in government revenue. However, if it is set at a somewhat higher level, it is likely to increase government revenue slightly, with an increase in VAT and a decrease in excise tax, but overall reflecting an increase.

MUP impact on consumption and health: The Sheffield Model

The Sheffield model uses consumption data from the 2016 South African Demographic and Health Survey (SADHS) and prices from the International Alcohol Control Study (IAC), along with a number of other data inputs, to populate an epidemiological policy appraisal model. The model disaggregates results by drinker and wealth groups in order to investigate the equity impact.

For the baseline, the Sheffield model estimates the health impact if the Western Cape does not introduce any alcohol harm reduction policies. In the event of no new policy, the Western Cape Province is predicted to experience 49 000 alcohol-attributable deaths and 9 703 000 alcohol-attributable cases of HIV, TB, intentional injury, road injury, liver cirrhosis, and breast cancer in the next 20 years (rounded to the nearest 1000).

With an R8 MUP the model estimates a 2.0% reduction in mean consumption, resulting in 942 deaths averted (50/3,000 for R5/R12) and 273,000 cases averted (17 000/906 000 for R5/R12) over 20 years. The poorer groups, and especially the heavy drinkers in these groups, gain proportionally more of the health benefit, due to the distribution of the health conditions at baseline (i.e. the poor suffer more from ill health to begin with). The model also estimates an increase in retail revenue and taxation revenue at all MUP levels.

Choosing the right MUP level

The choice of level for the MUP will be taken by the Western Cape Government. The higher the level, the more effective the MUP will be in reducing consumption; however, it also needs to be politically feasible. An analysis of CPI data has demonstrated how increasing categories of alcohol are affected as the threshold rises. The CPI data is typically collected in formal sector outlets. Ales and other sugar-

sweetened beverages, and very cheap wines (e.g. the so-called rooi-proppies) are not included in Statistics South Africa's sampling frame. Thus, the statistics are indicative, but certainly not comprehensive. Within this limitation of data coverage, the first category of alcohol to be affected by an MUP is wine sold in 5-litre and 3-litre boxes. As the MUP is increased, it will impact vodka, brandy and beer, roughly in that order.

We recommend that the level is set as high as economically and politically feasible, but stress that it is essential to set it at the same level across all categories of alcohol. The MUP would focus on the alcohol content of the beverage. Currently a standard unit of alcohol in South Africa is defined as 15 ml of pure ethanol. For example, for a 750 ml bottle of beer (with 5.5% ABV), the minimum retail price would be (750 x 0.055)/15 = 2.75 x the MUP. For a 750 ml bottle of wine with 12% ABV, the minimum retail price would be (750 x 0.12)/15 = 6 x the MUP. If the MUP is set at different levels for different categories of beverages, it would render the policy ineffective, with heavy drinkers able to switch their consumption to an alternative beverage. We also recommend that increases to the MUP should be built into the legislation so as to account, at least, for inflationary pressures.

Conclusion

This report has set out to demonstrate quantitatively the potential impact of MUP on consumption and harm in the Western Cape Province. The modelling suggests that MUP would reduce consumption and alcohol related harm, particularly amongst the heaviest drinkers and the poorest groups. The higher the threshold of the MUP, the greater the decrease in consumption and consequent health impacts.

The UCT model estimates a far greater consumption impact (11.5% at R8) than the Sheffield model (2% at R8) and considerable work has gone into comparing data and methods in order to understand the drivers of this difference. The key difference is the pricing data, with the Sheffield Model using IAC prices which suggest far higher mean prices at baseline than the prices estimated using NIDS data. The NIDS data are derived from respondents' declared expenditure on alcohol and alcohol consumption figures. For many households the derived prices are lower than the lowest alcohol prices that are found in formal alcohol outlets. This suggests that either heavy drinkers in NIDS systematically under-report their expenditure on alcohol, or that they access very cheap alcohol that are not sold in formal outlets. If the prices derived from the NIDS surveys understate the true level of retail prices, then the UCT model overstates the impact of the MUP.

Further research should prioritise the collection of pricing data. This dataset would need to provide detailed retail prices, coupled with information about the drinking patterns of the purchaser, similarly to the International Alcohol Control Study but ideally with a larger sample size and specifically carried

out in the Western Cape Province. This price collection survey should include the very cheap ales and wine that would typically be missed by surveys that focus on the more formal outlets.

Both models using different methods agree that MUP is an effective policy to reduce alcohol consumption, and therefore harm, in South Africa and in particular in the Western Cape Province. Both models also estimate that the greatest reduction in alcohol consumption, in absolute terms, accrues to heavy drinkers. In the Sheffield model this means that they then go on to accrue the greatest health benefits with the introduction of MUP.

We would like to highlight that the models have not estimated the reduction in harm to non-drinkers (for example from intimate partner violence and foetal alcohol spectrum disorders) which would result from the reduced consumption. We have only captured a limited number of health harms specific to the drinker. As such, this work presents a lower bound of the beneficial impact of an MUP policy.

Summary of key points: Modelling the impact of an MUP in the Western Cape

1. MUP is estimated to reduce consumption of alcohol.
2. The greatest absolute reduction in consumption would accrue to the heaviest drinkers.
3. Retail revenue would increase for the alcohol industry.
4. Alcohol related health harm would decrease, which will save lives and reduce healthcare costs.
5. Government revenue is estimated to increase if the MUP is set at R10 or above according to the UCT model and would increase at any level according to the Sheffield model.
6. This modelling only captures part of the alcohol-attributable harm. No modelling has yet captured the reduction in harm to others, including but not limited to violence to non-drinkers and foetal alcohol spectrum disorders (FASD).
7. Detailed (local) pricing data are necessary, collected alongside consumption patterns, to increase the reliability of estimates.

1. INTRODUCTION

South Africa has a significant problem associated with the hazardous and harmful use of alcohol. Even though the majority of the adult population indicate that they do not consume alcohol, nearly half of all alcohol consumers indicate that they consume alcohol in excess (i.e., five or more drinks on a typical drinking day) (Vellios and Van Walbeek, 2018). South Africa has a particularly poor pattern of drinking. A poor pattern of drinking is characterised by large quantities of alcohol consumed per drinking occasion, festive drinking, drinkers often getting drunk, and drinking in public places. On the other hand, drinking not to intoxication, having some alcohol free days each week and drinking with meals are generally regarded as better patterns of drinking. Only Russia and the Ukraine have patterns of drinking that are more harmful than South Africa's (WHO Global Status Report on Alcohol and Health, 2018).

The WHO indicates that interventions at a global, regional, national and sub-national level are required to address the harmful use of alcohol (World Health Organisation, 2018). There is no single strategy that will address this problem. It requires a multi-pronged approach (World Health Organisation, 2018). This study focuses on price-based interventions. In fact, price-based policies (specifically those that increase the price through increased taxation) are often regarded as "best buys" by the WHO, indicating that they are particularly cost-effective in reducing the premature mortality associated with the use of alcohol and other harmful products (WHO and World Economic Forum, 2011). A large number of studies have pointed out that an increase in the price of alcohol decreases the demand for the product (Wagenaar et al., 2009). Historically, governments imposed an excise tax on alcohol to raise revenue. As other revenue sources were exploited, the relative importance of alcohol taxes as a source of revenue has decreased. In the more recent past, there has been an increased focus on using fiscal means (primarily excise taxes) to improve public health and to reduce the consumption of harmful products, such as tobacco, alcohol and sugar-sweetened beverages (Blecher, 2015). In this context, the WHO strongly encourages countries to use alcohol excise taxes to reduce the demand for alcohol (World Health Organization, 2021 forthcoming).

In South Africa, as in other countries, the central government imposes an excise tax on alcohol products. Provincial governments do not exercise this authority. In South Africa, the excise tax is levied as a specific tax, i.e., a certain amount per litre of alcohol in the case of beer and spirits, and a certain amount per litre of wine, irrespective of the alcohol content. According to the National Treasury's review of alcohol taxation (Republic of South Africa, 2014), the excise tax is set such that the total consumption tax burden (i.e., the sum of excise tax and VAT, expressed as a percentage of the average retail price) is 23% for wine, 35% for beer and 48% for spirits. Removing the effect of VAT (which was 14% in

2014, translating to 12% of the VAT-inclusive price), the excise tax burden is targeted at 11% for wine, 23% for beer and 36% for spirits (National Treasury Department, 2021) Within this framework, the government applies some discretion in setting the level of the excise tax. For example, in the Budget for 2021/22, the government increased the excise tax on all alcohol products (other than sorghum beer) by 8% (Republic of South Africa, 2021). This was well above the inflation rate and above the expected increase in the price of alcohol. The implication of this move was to increase the total excise tax burden on alcohol products, above the targets that have been set.

An increase in alcohol excise taxes increases the price of alcohol (Russell and Van Walbeek, 2016) which in turn reduces the demand for alcohol, across all drinker types. Moderate drinkers tend to be more price responsive than heavy drinkers (Wagenaar et al., 2009), which means that tax-induced price increases will result in a larger percentage decrease in consumption among moderate drinkers than heavy drinkers. The public health effect of such a population-wide decrease in alcohol consumption is positive but not to the same magnitude as a MUP as the increase in the excise tax is not well targeted to heavy drinkers who suffer the largest share of harm. As such, an increase in the alcohol excise tax is a relatively blunt instrument, in that it also affects untargeted categories of drinkers.

In order to be more targeted, or because they may not have the legal authority to increase the excise tax, some jurisdictions (for example the Northern Territory of Australia) have implemented minimum prices on alcohol. In such cases, retailers are unable to sell alcohol at a price less than the minimum price stipulated. In the case of a minimum unit price (MUP), the minimum price is based on the volume of alcohol in the beverage, rather than on the volume of the beverage itself. In South Africa, a "unit" of alcohol is defined as 15 ml of ethanol. In Report 2 of this project, we present two case studies of jurisdictions that have implemented such minimum pricing strategies. These are Scotland and Northern Territory of Australia, although we also present alternative pricing policies from Russia and Botswana. Studies that have evaluated these interventions indicate that they have been successful at reducing heavy drinking (see references in Report 2).

In line with the experience of many other countries, heavy drinkers in South Africa pay a substantially lower average price for their alcohol than moderate drinkers (OECD, 2021). Set at an appropriate level, an MUP could substantially raise the price of very cheap alcohol but would have little or no effect on the price of more expensive alcohol. A recently published study by Van Walbeek and Chelwa (2021) investigated the feasibility and the likely impact of an MUP on various categories of drinkers in South Africa. Alcohol-consuming households were classified into moderate drinking households, intermediate drinking households, occasionally heavy-drinking households and regularly heavy-drinking households. Using data from the fourth wave of the National Income Dynamics Study (NIDS),

Van Walbeek and Chelwa were able to calculate the unit values (an indicator of the average price paid) for these four types of drinking households. An additional epidemiological model built specifically for South Africa estimates that the greatest health benefits would accrue to the heaviest drinkers and crucially to the poorest groups (Gibbs et al., 2021).

Even though both studies found that intermediate and heavy drinkers are substantially less responsive to changes in the price of alcohol than moderate drinkers, an MUP on alcohol products could have a substantial impact on their alcohol consumption, because an MUP policy is likely to substantially increase the price of alcohol that these drinkers typically consume. The decrease in consumption is driven by the often very large increase in the price of the products that these drinkers drink. If the aim of a pricing policy is to reduce the alcohol consumption of heavy drinkers, and possibly of intermediate drinkers, while not affecting the consumption of moderate drinkers, an MUP policy is a particularly sharp and targeted instrument.

The intermittent restrictions on alcohol sales during the Covid-19 lockdown have led to greater awareness of the poor drinking patterns of many South Africans and associated harms, especially trauma and unnatural deaths. Whenever the sale of alcohol was banned, the number of trauma cases presenting at hospitals decreased, but increased again sharply when the sales ban was lifted (Manyoni and Abader, 2021). The number of unnatural deaths, especially over weekends, decreased substantially when the alcohol sales ban was in place (Barron et al., 2020).

In a media briefing in 2020, the premier of the Western Cape, Mr Alan Winde, indicated that the Western Cape Government is considering implementing a MUP policy on alcohol in the province. This announcement acknowledged the fact that the Western Cape has a significant alcohol problem, but also that the provincial government wanted to address the problem.

This study was commissioned by the DG Murray Trust to support the implementation of such a policy. It consists of a number of reports. This first report considers the rationale for implementing an MUP in the Western Cape and aims to quantify the impact that such a policy would have on drinking patterns and alcohol-related mortality and morbidity in the province. This report consists of four sections, the first of which is this introduction. Section 2 then presents the results of a modelling exercise (the UCT Model) focused on the expected change in consumption by the four types of drinking households identified earlier, for different MUP levels. Section 3, which is based on different data sources and methods (the Sheffield Model, presents the results of an epidemiological model that considers the likely impact of an MUP on the mortality and morbidity of six alcohol-related illnesses, over a 20-year period. Both of these modelling sections were completed by the authors of the previously published national

studies (Van Walbeek and Chelwa, 2021, Gibbs et al., 2021) but adjust the work and data to make it specifically appropriate to the Western Cape Province. Section 4 of this report presents the results of an analysis on how different levels of the MUP would affect the prices of different categories of alcohol, i.e., beer, wine, brandy, whiskey, vodka and other types of alcoholic beverages. The conclusion draws inferences from the quantitative analysis. It also includes a comparison of the two modelling approaches and why the quantitative results are rather different.

2. MUP IMPACT ON CONSUMPTION: THE UNIVERSITY OF CAPE TOWN MODEL

2.1. Data and methodology

The main data source for this section is the fourth wave of the National Income Dynamic Study (NIDS). The survey was conducted in 2014. NIDS is the country's first household panel study and asks respondents (both individuals and households) a set of questions that allow researchers to investigate a range of socio-economic issues. The first round of NIDS was nationally representative, but, because of attrition, subsequent rounds are not fully nationally representative. Nevertheless, it remains an important resource. All data are weighted, using the published weights.

For this study, we focus on the Western Cape. In round 4 of NIDS, the Western Cape sample included 4543 individuals and 1115 households. Of the weighted households in the Western Cape, 50.9% indicated that they consume alcohol. Drinking households were classified as follows:

A *moderate drinking household* is defined as a household where the person with the highest alcohol consumption drinks one or two standard drinks per drinking day, irrespective of the number of days.
An *intermediate drinking household* is a household where the person with the highest alcohol consumption drinks three of four standard drinks per drinking day, irrespective of the number of days.
An *occasional heavy drinking household* is a household where at least one person drinks five or more standard drinks per day, but drinks no more than two days per week.
A *regular heavy drinking household* is a household where at least one person drinks five or more standard drinks per day, for three or more days per week.

Unit values for each household were calculated by dividing the reported monthly household expenditure on alcohol by the total monthly consumption of alcohol of the individuals that comprise the household. One can think of unit values as the average price paid for the product. Differences in unit values are primarily due to quality differences and errors in measurement. In the rest of the report, "unit value" and "price" will be treated as synonyms.

Monthly alcohol consumption per individual is calculated from two questions in the adult NIDS questionnaire (NIDS, 2015). The first is: "How often do you drink alcohol?" with options: "I have never drunk alcohol", "I no longer drink alcohol", "I drink very rarely", "less than once a week", "on 1 or 2 days a week", "on 3 or 4 days a week", "on 5 or 6 days a week", and "every day". The second question is: "On a day that you have an alcoholic drink, how many standard drinks do you usually have?". This question has the following 6 options: 13 or more, 9 to 12, 7 to 8, 5 to 6, 3 or 4, and 1 or 2 standard

drinks. NIDS defines a standard drink as a “small glass of wine; a 330 ml can of regular beer, a tot of spirits or a mixed drink”. Because it is well-known that people tend to under-report their alcohol consumption (Vellios and Van Walbeek, 2018), we used the upper limit of the categories of both questions to calculate the monthly consumption. For people that reported that they typically drink 13 or more standard drinks on a typical drinking day, we used 15 drinks.

Since the survey was conducted in 2014, we adjusted the calculated unit values to account for inflation. Between June 2014 and May 2021, the price of alcohol has increased by 45%, based on the Consumer Price Index (CPI). Thus, all unit values were multiplied by 1.45 to bring the values in line with current (2021) prices. If an MUP were to be imposed, it would change the price of the beverages that have been purchased at a price less than the amount of the MUP. A MUP will not have an impact on products where prices are higher than the MUP. On the assumption that, after the MUP is imposed, people are unable to buy alcohol at a price less than the MUP, they would then adjust their consumption, taking the higher prices into account. Different categories of drinking households react differently to a change in price, with heavy drinkers typically less responsive than moderate drinkers (Wagenaar, 2009).

Based on previous work (Van Walbeek and Chelwa, 2018), which aligns very closely to the international literature (Wagenaar et al., 2009), we used the following price elasticity of demand estimates for the various categories of drinking households: moderate drinking, -0.45; intermediate drinking, -0.35; occasional heavy drinking. -0.22 and regular heavy drinking: -0.18. The price elasticity values allow one to quantify by what percentage drinkers will reduce their alcohol consumption when faced by a price increase. For some drinkers, who are consuming very cheap alcohol at the outset, the percentage increase in the price can be very substantial. As will be shown below, depending on the level where the MUP is set, this could mean that the price can increase by 200% or more. In order to account for potentially very large increases in the price, we used the so-called arc formulation of the price elasticity (Mohr, 2020). This formulation gives more realistic estimates of the new consumption levels, especially where the price changes are large.

In an iterative exercise, we applied different levels of the MUP and recorded the expected change in the alcohol consumption of the four categories of drinking households. The results of this exercise are shown below.

2.2. Results

The Western Cape compared to the country

The drinking profile of the Western Cape differs substantially from that of the country as a whole. Whereas 33% of adults in the entire country indicate that they consume alcohol, the proportion is 44% in the Western Cape. While drinking is relatively more prevalent in the Western Cape, the prevalence of regular heavy drinking in the Western Cape is substantially lower, and the prevalence of moderate drinking is relatively higher, than in the country as a whole. Compared to the rest of the country, cheap wine is consumed in the Western Cape (Van Walbeek and Chelwa, 2018). The consumption of beer in the Western Cape is relatively lower than in the rest of the country (See Table 1).

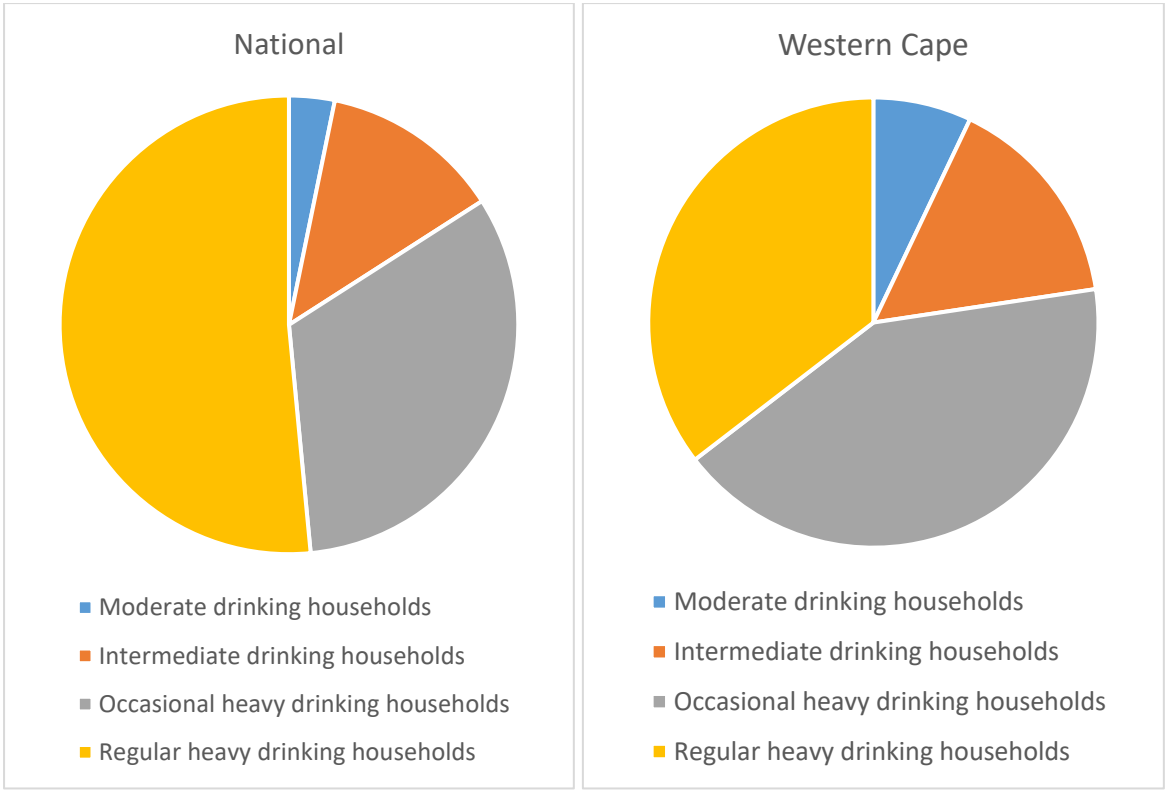
Table 1: Distribution of beer, wine and spirits consumption, by province, 2014

		Beer		Wine		Spirits		Total*	
	Adult pop. share	Percent. share	Index of beer use	Percent. share	Index of wine use	Percent. share	Index of spirits use	Percent. Share	Index of alcohol use
Western Cape	11.7	9.7	82.9	14.0	119.4	10.0	85.0	11.3	96.0
Eastern Cape	12.2	7.1	58.1	8.1	66.6	8.9	72.8	7.7	63.3
Northern Cape	2.1	2.5	122.2	1.7	82.8	1.7	80.0	2.1	102.1
Free State	5.2	6.1	116.6	6.7	127.4	7.4	141.5	6.5	124.1
KZN	18.9	12.8	67.6	9.0	47.5	13.1	69.5	11.5	60.9
North West	6.7	8.9	133.1	7.6	113.7	8.5	126.9	8.4	125.4
Gauteng	25.7	34.4	133.9	36.1	140.6	33.8	131.7	34.9	135.9
Mpumalanga	7.7	8.6	112.1	7.9	102.5	8.1	105.1	8.3	107.7
Limpopo	9.8	9.8	100.6	8.9	91.2	8.5	87.3	9.3	95.3
Total	100.0	100.0		100.0		100.0		100.0	

Note: The total was calculated as weighted average of beer (50%), wine (35%) and spirits (15%) consumption
Source: All Media and Products Survey, 2014

The volume of alcohol consumed by the various categories of drinkers, for both the Western Cape and the country, is shown in Figure 1. In the Western Cape largely cheap wine and beer is consumed, whilst nationally mostly beer. Nationwide, regular heavy drinkers drink more than half of all alcohol consumed. For the Western Cape, this fraction is just over a third. However, a substantially greater proportion of alcohol in the Western Cape is consumed by occasional heavy drinkers (42%) compared to the nationwide figure (33%). This finding coincides with previous findings that binge drinking, especially over weekends, is particularly common in the Western Cape (Gossage et al., 2014).

Figure 1: Volumes of alcohol consumed by different groups of drinking households



Source: NIDS Wave 4, 2014. N = 2057 for national survey; N = 383 for Western Cape.

Inhabitants of the Western Cape consume approximately 15% of all alcohol in South Africa. Since the population is about 11% of the total population, this implies that per capita alcohol consumption is between 30% and 40% higher than the per capita alcohol consumption of the country. As a percentage of the total volume of alcohol consumed by the various categories of drinking households, the Western Cape consumes about 34% of all moderately consumed alcohol, 19% of all intermediately consumed alcohol, 20% of all occasionally heavily consumed alcohol and just more than 10% of all regularly heavily consumed alcohol.

Alcohol prices by various categories of drinking households

As was indicated in the data and methodology section, we calculated unit values for each household by dividing the reported household expenditure on alcohol by the household's total reported consumption of alcohol. Using weighted data, we calculated the cumulative percentage of alcohol purchased by the four categories of drinking households for different price/unit value levels, from zero to R15.00 per standard drink. The unit values are shown in 2021 prices. In Figure 2, we indicate the situation for South Africa, while in Figure 3 we indicate the situation for the Western Cape.

Both figures clearly indicate that regular heavy drinking households tend to purchase their alcohol at very low derived prices. For the country as a whole, 59% of alcohol consumed by regular heavy drinking households is purchased for R2.00 per unit or less. For the Western Cape, 58% of alcohol consumed by regular heavy drinking households is purchased for R2.00 per unit or less. Regular heavy drinking households (92% in the country and 97% in the Western Cape) purchase nearly all their alcohol at an average price of R6.00 per unit or less. This does not suggest that regular heavy drinkers do not purchase any alcohol above this price, but that the *average* price that they pay is nearly always below R6.00 per unit.

At the other extreme, moderate drinking households tend to pay the highest average prices for alcohol. Moderate drinking households purchase 18% (for the country) and 11% (for the Western Cape) of their alcohol at a price of R8.00 per unit or less. At a price threshold of R12.00 per unit, these percentages increase to 37% (for the country) and 56% (for the Western Cape). The median price paid by moderate drinking households for a standard unit is R17.23 for the country and R10.58 for the Western Cape. To put this in perspective, this equates to R112 (for the country) or R69 (for the Western Cape) for a 750 ml bottle of wine.

Intermediate drinking households and occasional heavy drinking households have a similar price profile, both for the country and for the Western Cape. The average prices at which these two groups purchase their alcohol lies between the average prices paid by regular heavy drinking households and moderate drinking households. The median price paid by intermediate drinking households in both the Western Cape and the country is R7.48 per unit. The median price paid by occasional heavy drinking households is R9.73 in the Western Cape and R7.36 in the country. Again, for context, a price of R7.50 per unit of alcohol translates to R20.63 for a quart of beer (5.5% ABV), a beverage of choice for many intermediate and occasional heavy drinkers. As such, these median prices seem realistic.

Figure 2: Cumulative distribution of standard drinks consumed in South Africa, for various prices, across different categories of drinking households

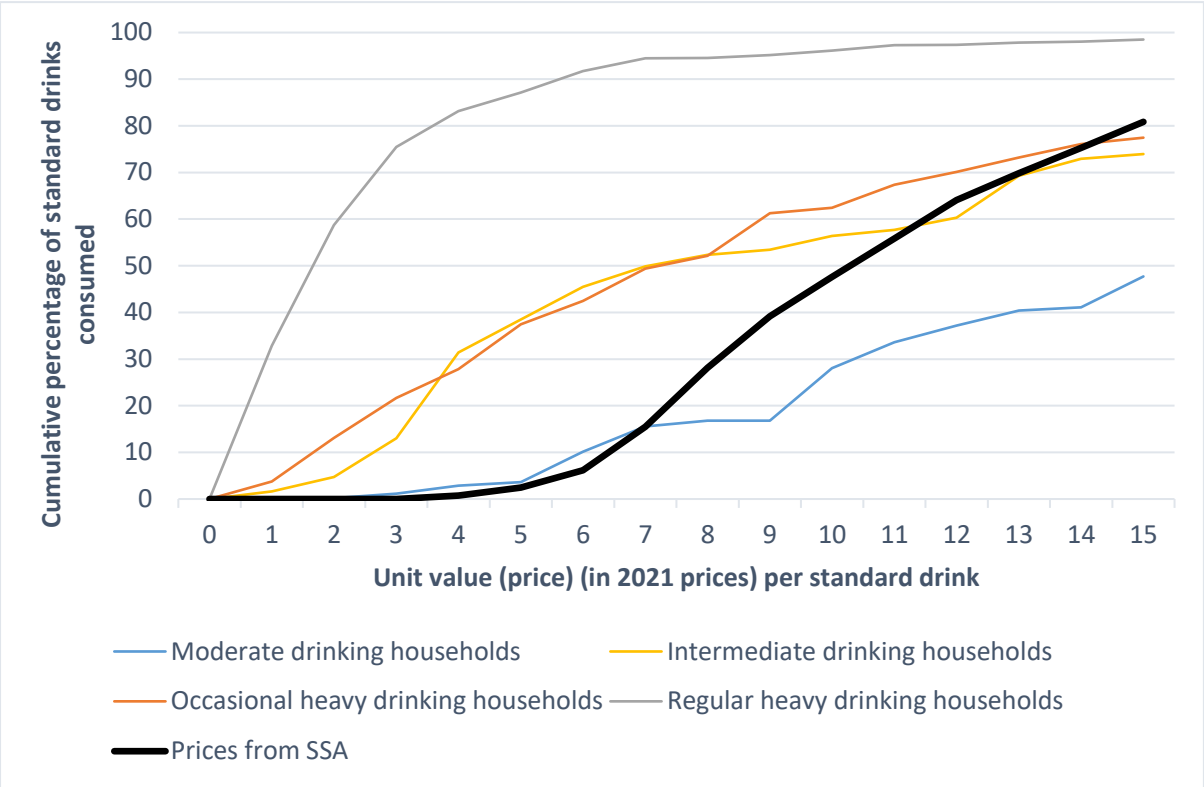
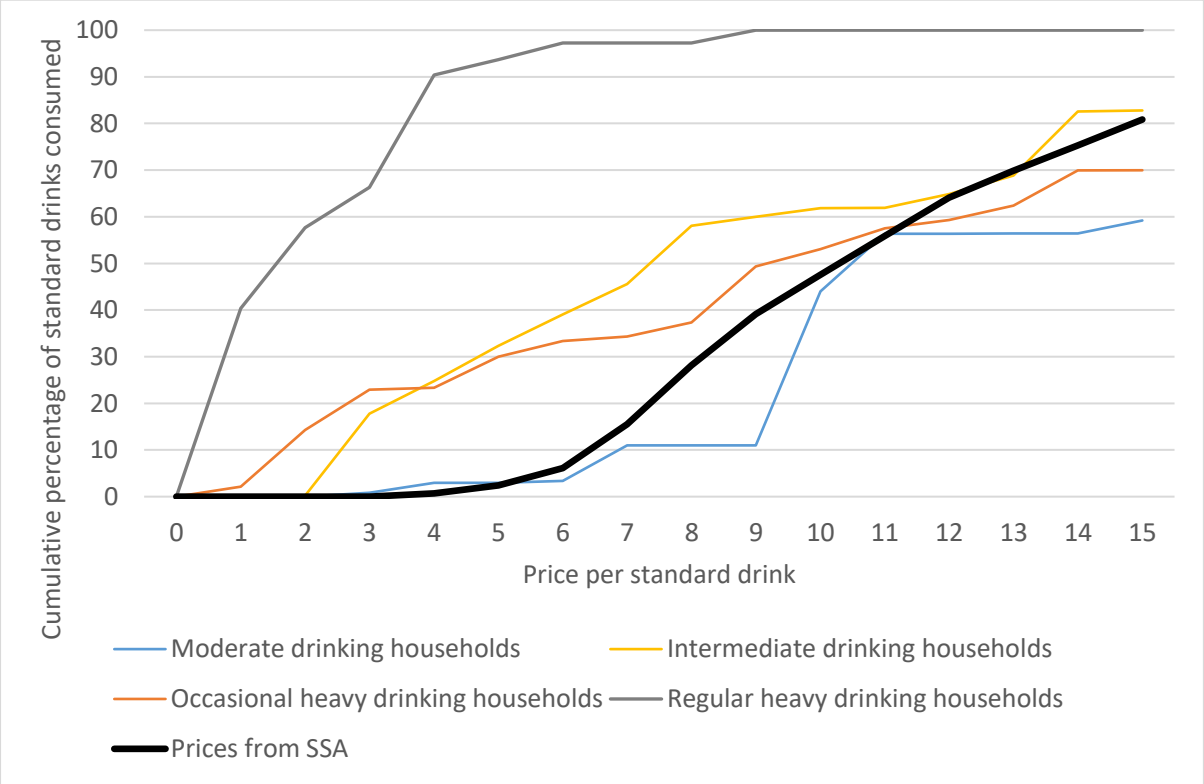


Figure 3: Cumulative distribution of standard drinks consumed in the Western Cape, for various prices, across different categories of drinking households



In both Figures 2 and 3 the bold black line indicates the cumulative distribution of alcohol prices per unit of alcohol, as collected by Statistics South Africa. These prices are indicative of prices sold in formal liquor outlets. They are collected as an input to calculate the inflation rate. Because they are unweighted, one should not attach too much value to them, but we have included them here as a rough indication of the prices of alcohol sold in formal outlets. The technicalities of how the data were derived and used are described in Section 4 and the associated appendices.

The prices paid by moderate drinking households, for the whole country and for the Western Cape, are generally higher than the prices collected by Statistics South Africa. This indicates that they purchase more expensive and "higher quality" alcohol than the alcohol that is monitored by Statistics South Africa. This result is unsurprising.

The distribution of prices, as reported by intermediate and occasional heavy drinking households, and especially regular heavy drinking households, does not follow the distribution of prices collected by Statistics South Africa. For prices below R12.00 per unit, intermediate and occasional heavy drinking households consume much more than they would if they had purchased their alcohol in line with the SSA prices. For all prices, regular heavy drinking households consume much more than they would have had they consumed alcohol in line with the SSA prices. There can be a number of reasons for this: (1) the SSA price line is not weighted by the quantities consumed, and is thus only a very rough indicator of alcohol prices, (2) there may be reporting errors in the expenditure and/or consumption data in the determination of the unit prices, and (3) the SSA prices do not adequately reflect the alcohol products purchased, and prices paid, by intermediate, occasional heavy, and regular heavy drinking households.

The aim of this report is not to criticise the SSA sampling frame for the collection of alcohol prices. While it is possible that there are reporting errors in the data, this analysis does suggest that a lot of alcohol, in particular at the bottom end of the price range, is not monitored by SSA. In particular, ales and sugar-fermented beverages are not monitored by SSA. These are often sold at very low prices. To address this apparent under-sampling of very cheap alcohol, REEP conducted its own informal survey of alcohol prices in the Western Cape, focusing on low prices, after the comprehensive alcohol sales ban was lifted on 26 July 2021. When the report was submitted on 15 August 2021, the results from the survey were not yet available. However, subsequently we received the data from the fieldworkers.

The results from our own fieldwork did not provide us with significantly more insights than we had from the SSA data. The lowest price was for wine, that sold at R3.00 per unit. Fieldworkers did not identify any very cheap ales or other sugar-sweetened beverages. Many liquor store owners were unwilling to divulge much information to the fieldworkers because they suspected that the fieldworkers

may have been sent by the authorities to "spy" on these outlets. This may have resulted in some cheap alcohol not being monitored by the fieldworkers. The report of the fieldwork conducted by REEP is attached as Appendix K.

Impact of an MUP on different categories of drinking households

Should an MUP be imposed in the Western Cape, it will have an impact on the retail prices of alcohol sold below the MUP level, but it should not have any impact on prices that are above that level. People who are purchasing alcohol at prices below the MUP would experience a price increase and have an incentive to reduce their alcohol purchases, as the law of demand predicts. The amount by which people would reduce their alcohol consumption depends on the price elasticity of demand. The price elasticity of demand is the percentage change in the quantity consumed because of a 1% increase in the price. International studies have shown that the price elasticity of demand for alcohol falls in the elastic range (i.e., a price elasticity between 0 and -1) (Wagenaar et al., 2009), but that heavy drinkers tend to be more price inelastic than moderate drinkers, i.e., they are less influenced by price than moderate drinkers.

In Table 2 we present the predicted percentage change in the quantity of alcohol consumed for the four categories of drinking households in the Western Cape for various MUP levels using the following price elasticity of demand estimates for the various categories of drinking households: moderate drinking, -0.45; intermediate drinking, -0.35; occasional heavy drinking. -0.22 and regular heavy drinking: -0.18.

Table 2: Expected consumption change for different categories of drinking households and MUP levels, Western Cape

MUP (in rands per standard drink)	Moderate drinking households	Intermediate drinking households	Occasional heavy drinking households	Regular heavy drinking households	Total
	(1)	(2)	(3)	(4)	(5)
2	0.0	0.0	-1.0	-8.6	-3.4
3	-0.1	-1.2	-2.4	-11.1	-5.1
4	-0.3	-2.9	-3.5	-13.5	-6.7
5	-0.6	-4.6	-4.4	-15.7	-8.2
6	-0.8	-6.4	-5.3	-17.4	-9.4
7	-1.3	-8.2	-6.1	-18.7	-10.5
8	-1.8	-10.0	-6.7	-19.8	-11.5
9	-2.3	-11.8	-7.4	-20.7	-12.4
10	-3.5	-13.4	-8.2	-21.5	-13.4
11	-5.4	-14.7	-8.9	-22.2	-14.3
12	-7.3	-15.9	-9.6	-22.8	-15.1
13	-9.0	-17.1	-10.3	-23.3	-15.9
14	-10.4	-18.2	-11.1	-23.7	-16.6
15	-11.8	-19.5	-11.8	-24.1	-17.4

For even very low MUPs, the impact of an MUP on alcohol consumption by regularly heavy-drinking households is substantial. For example, if the MUP is levied at R4.00 per unit, this is expected to decrease the quantity of alcohol consumed by regular heavy drinking households by 13.5%, of intermediate drinking households by 2.9%, and by occasional heavy drinking households by 3.5%. The expected impact on moderate drinking households will be very small (-0.3%). At this MUP level, the total volume of alcohol consumed in the Western Cape is expected to decrease by 6.7%.

As expected, if the MUP is levied at a higher level, it will result in larger expected decreases in alcohol consumption. However, this decrease differs for the various drinking categories. Drinker categories which are more price-sensitive (like intermediate drinkers and especially moderate drinkers) are affected relatively more than the two heavy-drinking groups, which are less price-sensitive. For example, if the MUP is levied at R12.00 per unit, this will decrease alcohol consumption among regular heavy drinking households by 22.8% (up from a 13.5% decrease when the MUP was R4.00), and by an expected 7.3% among moderate drinking households (up from a 0.3% decrease when the MUP was R4.00).

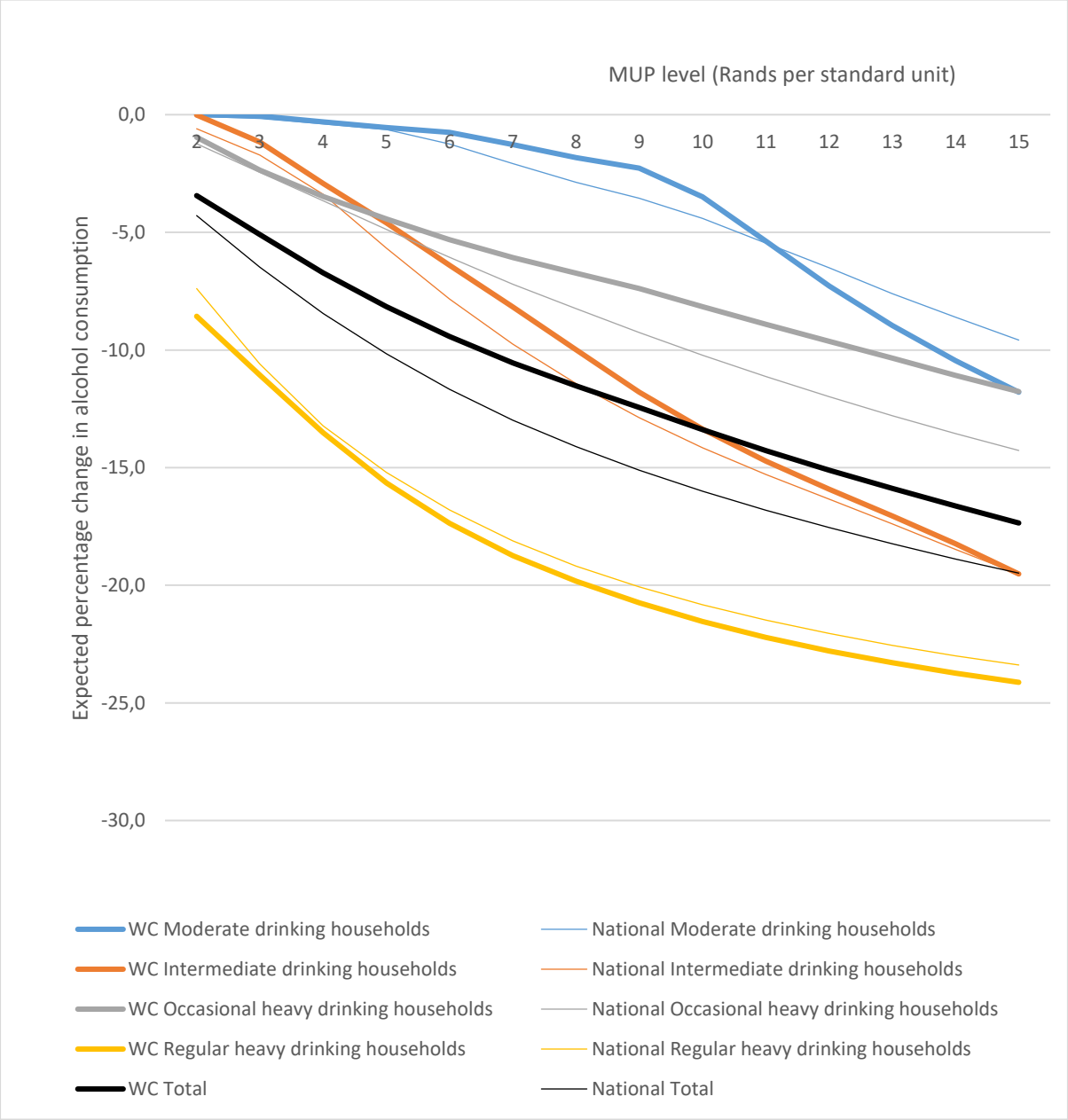
If a reduction in consumption among moderate drinkers, and even intermediate drinkers, is regarded as unwanted "collateral damage", then the collateral damage increases at an increasing rate as the MUP is ratcheted up.

In Figure 4 the results of Table 1 are illustrated graphically. The heavy lines indicate the expected percentage decrease in alcohol consumption for the various categories of drinking households in the Western Cape, for different MUP levels. As a comparison, the light lines, in the same colour, indicate the same thing, but for the whole country. The diagram illustrates the different responses by different categories of drinking households to different MUP levels, as was alluded to in the discussion above. The expected percentage decrease in alcohol consumption by intermediate and occasional heavy drinking households is roughly linear when the MUP is increased. However, because intermediate drinking households tend to be more price-sensitive than occasional heavy drinking households, the analysis indicates that intermediate drinking households are likely to decrease their consumption by a substantially greater percentage than occasional heavy drinking households as the MUP increases.

For regular heavy drinking households, the biggest impact is already very substantial for low levels of the MUP, and it increases, but at a decreasing rate, as the MUP increases.

For moderate drinking households the effect is quite different. At relatively low levels, an MUP has a modest impact on consumption. However, at MUP levels above R9.00 per unit the decrease in alcohol consumption becomes substantially greater.

Figure 4: Expected percentage change in alcohol consumption across different categories of drinking households and MUPs, Western Cape and national



Revenue impact

The primary aim of an MUP on alcohol is to reduce alcohol consumption among heavy drinkers. It is not to raise government revenue. At a national level, government revenues from alcohol taxes come from two sources: the excise tax and VAT. Imposing an MUP will reduce alcohol consumption, which in turn will reduce excise tax revenues. On the other hand, when the MUP is imposed, it will increase the average retail price at which the product is sold. The interaction of the decrease in alcohol volumes and the increase in the average price determines the likely impact of an MUP on VAT revenue. In this

section we provide some rough indications of the likely impact of a Western Cape MUP on the alcohol-related revenue of the country, bearing in mind that excise taxes and VAT are collected by the central government, not by the provinces.

Data constraints prevent us from doing a more thorough analysis. In particular, the analysis is performed on all alcohol, rather than on specific categories of alcohol. We focus on revenue data for the 2019/2020 financial year, because the sporadic alcohol sales bans and the extraordinary circumstances in 2020 and 2021 make these years inappropriate to use as a baseline.

In 2019/20, excise taxes on alcohol yielded R29.1 billion in government revenue for the country. On the assumption that the excise tax, as a percentage of the retail price, was 11% for wine, 23% for beer and 36% for spirits (these are the targets set by National Treasury), the total turnover of alcohol in South Africa is R141.2 billion. The total amount of VAT payable on this turnover is R18.4 billion. According to NIDS wave 4, 15.1% of South Africa's alcohol is consumed in the Western Cape. On the assumption that the Western Cape has a similar drinking profile as the rest of the country (i.e., drinkers in the province consume beer, wine and spirits in the same proportions as in the rest of the country)[1], the Western Cape's contribution to South Africa's alcohol excise revenue is R4.39 billion and to alcohol-related VAT revenue R2.78 billion.

Using the NIDS data, we estimate the weighted average price per standard drink at R11.04 per unit in the Western Cape. Imposing an MUP would push up the average price, because all alcohol that was previously sold at a price below the MUP will now be sold at the MUP level. Of course, the higher the MUP is set, the greater the volume of alcohol affected, and the bigger will be the change in the average price. The average price for the different MUP levels is shown in column (1) of Table 3, while the percentage change (relative to the base scenario) is shown in Column (2). At the same time, as indicated in the previous section, the imposition of an MUP would result in a decrease in alcohol consumption. In Column (3) of Table 3, which replicates Column (5) of Table 2, the percentage change in total alcohol consumption is shown. Column (4) of Table 3 indicates the percentage change in turnover. This percentage is calculated as $[(1 + \%\Delta P)\,(1+ \%\Delta Q)] - 1$, where $\%\Delta P$ is the percentage change in the price and $\%\Delta Q$ is the percentage change in the quantity.

[1] This is a strong assumption. It is well known that drinkers in the Western Cape consume relatively more wine than drinkers in other provinces (Van Walbeek and Chelwa, 2018). It is also well known that wine carries a substantially lower excise tax than beer or spirits. Thus, a decrease in wine consumption will result in a lower reduction in excise tax revenue than an equivalent decrease in the consumption of beer or spirits. The NIDS data do not allow us to investigate this in more detail. However, to the extent that the reduction in alcohol consumption in the Western Cape is primarily attributable to a reduction in wine consumption, the effect on government revenue will be reduced. Therefore, the possible reduction in government revenue as a result of the implementation of the MUP, should be seen as a worst-case scenario.

Table 3: The impact of different MUP levels on the average price, quantity and turnover of alcohol in the Western Cape

MUP (in rands per standard drink)	Average price	Percentage change in average price	Percentage change in quantity	Percentage change in turnover
	(1)	(2)	(3)	(4)
No MUP	11.04			
1	11.11	0.7%	-1.7%	-1.1%
2	11.31	2.4%	-3.4%	-1.1%
3	11.61	5.2%	-5.1%	-0.2%
4	12.02	8.9%	-6.7%	1.6%
5	12.50	13.2%	-8.2%	4.0%
6	13.02	18.0%	-9.4%	6.9%
7	13.58	23.1%	-10.5%	10.1%
8	14.17	28.4%	-11.5%	13.6%
9	14.78	33.9%	-12.4%	17.3%
10	15.46	40.1%	-13.4%	21.3%
11	16.17	46.5%	-14.3%	25.6%
12	16.91	53.2%	-15.1%	30.0%
13	17.66	60.0%	-15.9%	34.6%
14	18.45	67.2%	-16.6%	39.4%
15	19.27	74.6%	-17.4%	44.3%

Table 3 indicates, unsurprisingly, that as the MUP increases, the average price increases and alcohol consumption decreases. At very low levels of the MUP, its impact of the MUP is first to decrease the total turnover, but as the MUP increases to a level of R4.00 and above, turnover is expected to increase. The explanation for the decrease in turnover when the MUP is implemented at very low levels lies in the fact that the decrease in quantity of alcohol consumed is greater than the increase in the average price. As the MUP increases (for levels above R4.00 per unit), the average price increases by a greater percentage than the decrease in the quantity, reflecting the relative price inelasticity of the demand for alcohol.

Since the excise tax is levied as a specific tax (i.e. a specified amount per litre of alcohol in the case of beer and spirits, and a specified amount per litre of the beverage, irrespective of alcohol content, for wine), excise tax revenue is expected to be closely correlated with the quantity of alcohol consumed. On the assumption that the decrease in consumption of beer, wine and spirits caused by the imposition of the MUP is proportional to the volumes of these categories of alcoholic beverages consumed, the decrease in excise tax revenue is directly proportional to the decrease in the quantities, as indicated in Column (3) of Table 3.

Whereas the amount of excise tax revenue is largely a function of the quantity of alcohol consumed, the amount of VAT collected is closely correlated with the total turnover of alcohol. Total turnover is the weighted product of the quantity and the retail price and VAT is levied as a percentage of the VAT-excluded retail price. In Column (4) of Table 3 the predicted percentage changes in turnover is shown.

In Table 4, we indicate the predicted amounts of excise tax revenue, alcohol-related VAT revenue, and total alcohol-related tax revenue, together with the percentage changes in consumption, relative to the baseline, for different levels of the MUP.

Table 4: Impact of different MUP levels on government revenue

	% change	R million			Percentage change		
MUP level (rands per std. drink)	Consumption	Excise Revenue	VAT Revenue	Total Govt Rev	Excise Revenue	VAT Revenue	Total Govt Rev
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
No MUP		4393	2781	7174			
1	-1.7%	4318	2752	7070	-1.7%	-1.1%	-1.5%
2	-3.4%	4242	2751	6993	-3.4%	-1.1%	-2.5%
3	-5.1%	4169	2776	6945	-5.1%	-0.2%	-3.2%
4	-6.7%	4098	2825	6922	-6.7%	1.6%	-3.5%
5	-8.2%	4035	2892	6927	-8.2%	4.0%	-3.5%
6	-9.4%	3979	2972	6951	-9.4%	6.9%	-3.1%
7	-10.5%	3930	3062	6992	-10.5%	10.1%	-2.5%
8	-11.5%	3887	3158	7045	-11.5%	13.6%	-1.8%
9	-12.4%	3846	3262	7108	-12.4%	17.3%	-0.9%
10	-13.4%	3805	3375	7181	-13.4%	21.3%	0.1%
11	-14.3%	3766	3494	7260	-14.3%	25.6%	1.2%
12	-15.1%	3730	3616	7346	-15.1%	30.0%	2.4%
13	-15.9%	3696	3743	7439	-15.9%	34.6%	3.7%
14	-16.6%	3663	3876	7539	-16.6%	39.4%	5.1%
15	-17.4%	3631	4013	7644	-17.4%	44.3%	6.5%

For all MUP levels, the impact of an MUP on government revenue is likely to be modest. For MUP levels below R10.00 per standard drink, the model suggests that there might be a small decrease in revenues, but, as is pointed out in footnote 1, this is likely to be a worst-case scenario. Should the MUP be set at a level of R12.00 per unit, alcohol-related tax revenue is predicted to increase by 2.4%. Excise tax revenue, generated in the Western Cape for the national fiscus, is expected to decrease by R663 million (15%), while alcohol-related VAT revenue is expected to increase by R835 million (30%). Overall alcohol-related revenue is expected to increase by R172 million (2.4%).

2.3. Limitations of the study

In this report we analysed drinking patterns in the Western Cape, using the same methodology and data (NIDS wave 4) as we used for the whole country (Van Walbeek and Chelwa, 2021). The dataset has a number of flaws, which we point out below.

NIDS was not designed to investigate trends in alcohol use. It was primarily aimed at investigating socio-economic dynamics (such as trends in employment, income, poverty, and deprivation). The questions on alcohol use are part of a suite of questions on health behaviour. As such, the questions on alcohol use tend to be superficial. The questions only considered "alcohol", rather than the individual alcohol categories (i.e. beer, wine and spirits). While NIDS was designed to be nationally representative, it was not explicitly designed to be provincially representative. Also, over time, some groups experienced more attrition than others, which meant that the sample is less representative than it was supposed to be.

Because of the design of the NIDS questionnaire, the analysis of the unit values could only be done at the household level. While alcohol consumption data was collected at the individual level, alcohol expenditure data was collected at the household level. We are unable to comment about the prices/unit values paid by individuals in the household.

As is often the case in alcohol surveys, there is substantial under-reporting of alcohol-related consumption and expenditure (Probst, Shuper and Rehm, 2017, and Vellios and Van Walbeek, 2018). It seems plausible that the degree of under-reporting of alcohol expenditure among regular heavy drinkers is greater than among other drinkers. If alcohol expenditure is under-reported to a greater extent than alcohol consumption, this would explain the particularly low unit values found for heavy drinking households. The fact that we were unable to find retailed alcohol that was selling for less than R3.00 per standard unit, suggests that there may be a systematic bias in the reported expenditures of heavy drinking households. If this is the case, then the predicted decrease in alcohol consumption when an MUP is imposed, might be overstated. As with all research, one should take cognisance of the limitations and interpret the results with caution.

The focus of the study was intentionally narrow. Its focus was on consumption behaviour of different groups of drinking households. It tangentially considered the government revenue impacts. It did not consider the health and social impacts of an MUP. It seems likely that these will be substantial, especially among heavy drinkers. A reduction in heavy drinking is likely to result in a decrease in

alcohol-related hospitalisations, with obvious fiscal benefits. This is addressed in the next section of this report.

2.4. Conclusion

This analysis has shown that a province-specific MUP has the potential to reduce alcohol consumption in the Western Cape substantially, especially among regular heavy drinkers, but also among occasional heavy drinkers and intermediate drinkers. Unless the MUP is set at levels above R10.00 per standard drink, the impact on moderate drinking households will be modest. For example, if set at R8, an MUP is expected to decrease alcohol consumption of regular heavy drinking households by nearly 20%, of occasional heavy drinking households by nearly 7%, of intermediate drinking households by 10% and of moderate drinking households by nearly 2%. Total alcohol consumption in the Western Cape is expected to decrease by 11.5%.

The effectiveness of an MUP, as a harm-reduction mechanism, rests crucially on the hypothesis that heavy drinkers consume cheap alcohol. The international literature clearly supports this hypothesis (Wagenaar et al., 2009). In fact, in jurisdictions that have successfully implemented MUPs, the policy is premised on the finding that heavy drinkers consume cheap alcohol (see Report 2). The results of this analysis overwhelmingly indicate that heavy drinking households in the Western Cape consume very cheap alcohol, although the effect might be exaggerated by the fact that heavy drinkers might systematically understate their alcohol expenditures. The reported prices are so low that it seems unlikely that these heavy drinking households purchase all their alcohol through regular outlets. In chapter 4 of this report, we investigate the prices of commercially sold alcohol products in more detail.

Should an MUP be implemented, its effectiveness in reducing alcohol consumption will depend greatly on the level at which the MUP is set. The higher the MUP is set, the more impact it will have. However, even at relatively low levels, an MUP can have a substantial impact on the drinking behaviour of regular heavy drinkers, and a more modest impact on occasional heavy and intermediate drinkers. Whereas an increase in the excise tax on alcohol products is expected to increase government excise tax revenue, an MUP is not aimed at raising revenue but also takes into account other benefits associated to the associated economic, social and health costs (Matzopoulos, Truen, Bowman and Corrigall, 2014). In this analysis, we showed that an MUP would have a limited impact on government revenue, increase revenue for retailers and the effect of reduced consumption would benefit government and society more broadly.

3. MUP IMPACT ON CONSUMPTION AND HEALTH: THE SHEFFIELD MODEL

3.1. Infographic

3.2. Introduction

This section of the report presents our modelling appraisal of minimum unit pricing (MUP) in the Western Cape province of South Africa. We estimate the impact of the policy on alcohol consumption, alcohol expenditure, taxation, retail revenue, and health outcomes. We include only a limited number of health conditions which are affected by alcohol, owing to the constraints of the project. These are HIV, TB, interpersonal violence and self-harm (intentional injury), road injury, liver cirrhosis, and breast cancer. HIV, intentional injury, and road injury are most affected by a pattern of heavy episodic (or binge) drinking. It should be noted that there are many other conditions related to alcohol which have not been modelled, including but not limited to diabetes, heart disease, and many other forms of cancer (Shield et al., 2020).

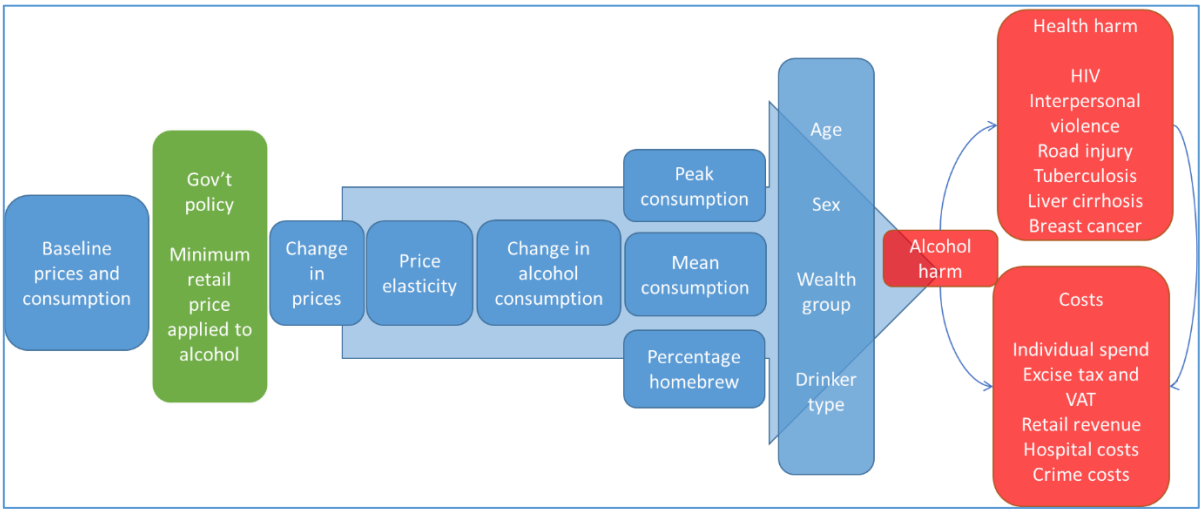
This model was adapted from previous work which modelled the impact of MUP at a national level (Gibbs et al., 2021). The original national model was built alongside a programme of stakeholder engagement which included academics, policy professionals, and civil society members. We present here a brief overview of the methods and model inputs for the Western Cape. Further detail is included in the appendices. We present the results and some points for discussion.

3.3. Methods

Overview

Our model is most easily understood with the help of an illustration (Figure 5). The model starts with data on prices and consumption before an MUP is implemented. We then model the impacts of an MUP on prices – with the prices of the cheapest alcohol increasing to the MUP level and all prices above remaining unchanged. These changes in prices are then combined with estimates of the price elasticity of alcohol, which quantifies how consumers reduce their purchasing when faced with a price rise. This leads to reductions in alcohol consumption when prices rise, which are concentrated in those who bought the cheapest alcohol before the MUP was introduced. Our modelling accounts for patterns of consumption, as well as the overall volume that people drink, as some health conditions are associated with risks from intoxication rather than from longer-term chronic drinking. The model accounts for differences in drinking, prices paid, and health by age, sex, wealth and drinker type. The final steps in the model are to estimate how reductions in consumption, as a result of the policy, lead to lowered risks of the health conditions, seen in the upper red box, and how this results in savings on healthcare costs. We also model a number of other costs, seen in the lower red box.

Figure 5: Conceptual model



Adjusting the national model to the Western Cape Province

The foundational dataset used in the national model is the South African Demographic and Health Survey 2016, as it offered a number of advantages over other datasets, such as its inclusion of peak drinking (the highest amount consumed on one occasion) and homebrew consumption. However, it does not provide a large enough sample to use only Western Cape observations for a provincial model.

The National Income Dynamic Study (NIDS) wave 4 survey, which asks respondents about their alcohol consumption, offered a larger sample. Therefore, the NIDS data was examined for differences between the national population and the Western Cape province. The summary data clearly showed that the Western Cape differs from the national profile. It has different proportions of racial or population groups, including smaller Black African populations and larger Coloured and White populations and, crucially, it has a higher prevalence of drinking. In order to reweight the SADHS data to represent the Western Cape province, proportions were taken from NIDS and a reweighting process was applied, focusing on reweighting for population groups, sex, and drinking prevalence (Appendix part A and B)

The model groups drinkers into three categories (Table 5). These definitions are very similar to those used in the UCT model although they do not include an intermediate drinker category as the SADHS data, used for the consumption estimates, did not support this category. Research has demonstrated that purchasing prices vary and response to a price increase also varies by drinker group (van Walbeek and Chelwa, 2019, Van Walbeek and Blecher, 2014). Our inputs show that heavy drinkers buy slightly

cheaper alcohol, for some wealth quintiles, but will reduce their drinking by less when faced with a price increase compared to moderate drinkers[2].

Table 5: Drinker definitions

Drinker type	Drinks per week
Moderate	fewer than 15 drinks a week
Occasional binge	fewer than 15 drinks a week but drinks more than 5 at a time
Heavy	15 drinks or more a week

The baseline year in the model is 2018. The impacts of MUP on consumption are given for a one-year impact. For the health outcomes, the model uses a time horizon of 20 years in order for the full effect of all of the health conditions to be realised. Breast cancer and liver cirrhosis have a lag between the reduction in drinking and the realisation of the health benefit. Tuberculosis was not included in the national model but was added to the Western Cape model at the request of the research consortium as an important and high-profile health issue in the Western Cape.

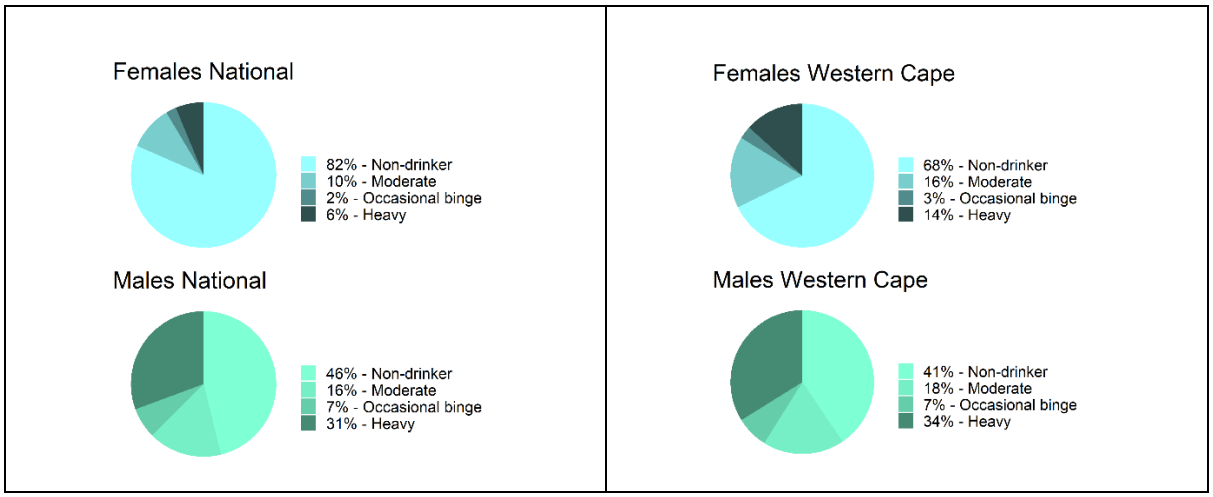
We vary the price elasticities used in the model to see how the results are impacted. We compare the baseline elasticities with elasticities based only on drinker type. The model simulates results for a R5, R8 and R12 MUP. Most results are presented for R8 but comparison across the levels is also provided for the health impact.

3.4. Data inputs

The following tables and graphs highlight model inputs. We can see that prevalence of drinking in the Western Cape is estimated at 32% for females, 59% for males. This is higher than national levels, which are provided for comparison (Figure 6).

[2] A standard drink is defined as 15ml or 12 grams of pure ethanol.

Figure 6: Prevalence of drinking by drinker group; comparing national and the Western Cape



The model uses national wealth *quintiles* to group people. However, as the Western Cape is comparatively wealthier, these nationally-defined groups are not equally sized in the Western Cape (Table 6). We have therefore renamed these as wealth *groups* to highlight that they are no longer equally sized. Most inputs are drawn from national data and are disaggregated using national wealth quintiles; appropriate adjustments are then made to align the data to the Western Cape population. A range of model inputs are reported here (Table 6).

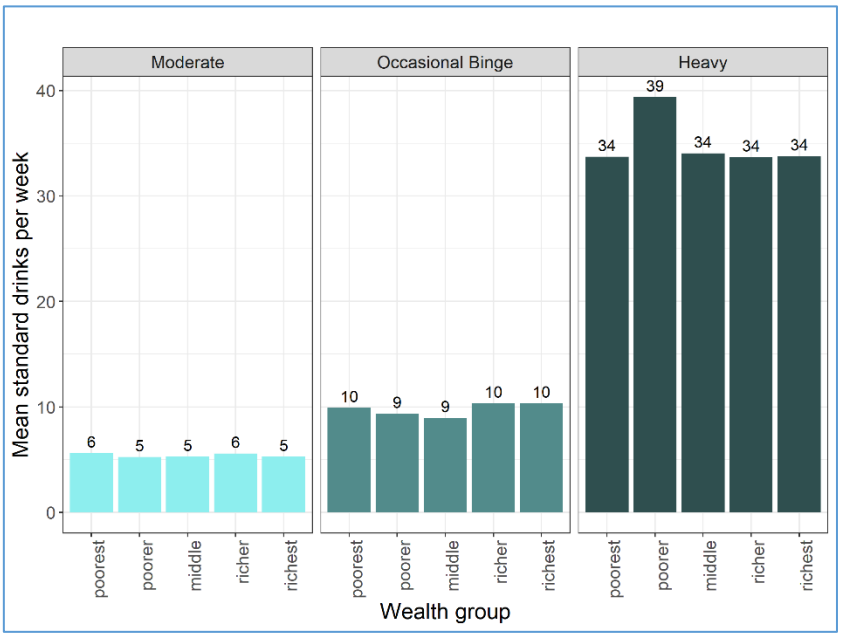
Table 6: Key inputs to the model by wealth groups (Western Cape)

	Wealth groups (Q1 = poorest)					
	Q1	Q2	Q3	Q4	Q5	Source
Proportion of population in each wealth group	9%	9%	17%	27%	37%	SA DHS 2016 adjusted using raking method and NIDS proportions of population group, sex and drinking prevalence.
Alcohol consumption, prices and elasticities						
Prevalence of drinking	46%	52%	47%	40%	45%	SA DHS 2016 reweighted using NIDS Wave 4 to represent Western Cape
Prevalence of heavy drinking (15 or more standard drinks per week)	24%	27%	23%	20%	23%	SA DHS 2016 reweighted using NIDS wave 4 to represent Western Cape, calibrated to Euromonitor
Mean individual baseline consumption (standard drinks per week)	10	12	9	8	9	SA DHS 2016, reweighted to represent Western Cape, calibrated to Euromonitor
Mean price per standard drink Moderate Occasional binge Heavy	 R9.1 R8.0 R7.8	 R9.1 R10.0 R9.7	 R9.1 R10.1 R9.2	 R11.6 R13.4 R10.6	 R11.6 R11.1 R12.7	International Alcohol Control Study (2014) adjusted for inflation to 2018 prices, adjusted using CPI data, SAWIS data, and price points from local Western Cape research on cheap wine

Price elasticity[3] by drinker groups						
Moderate	-0.53	-0.53	-0.31	-0.31	-0.31	van Walbeek and Chelwa (2019)
Occasional binge	-0.29	-0.29	-0.17	-0.17	-0.17	authors' calculations (Appendix
Heavy drinkers	-0.24	-0.24	-0.14	-0.14	-0.14	part C)
Share of disease at baseline using national data						
HIV	20%	36%	32%	9%	3%	Authors' calculations using GHS 2018
Intentional injury, road injury and liver cirrhosis	9%	29%	26%	26%	10%	Authors' calculations using GHS 2018
Breast cancer	7%	7%	22%	18%	47%	Authors' calculations' using GHS 2018
TB	25%	30%	31%	12%	3%	Authors' calculations' using GHS 2018
Annual healthcare costs per case associated with treating the disease/condition (all inflated to 2018 prices)						
HIV	R3,319					Meyer-Rath et al. (2019)
Intentional injury	R49,239					Norberg et al. (2009)
Road injury	R77,771					Parkinson et al. (2014)
Liver cirrhosis	R2,502					Health Systems Trust (2020)
Breast cancer	R17,468					Guzha et al. (2020)
TB	R4,634					Pooran et al. (2013)

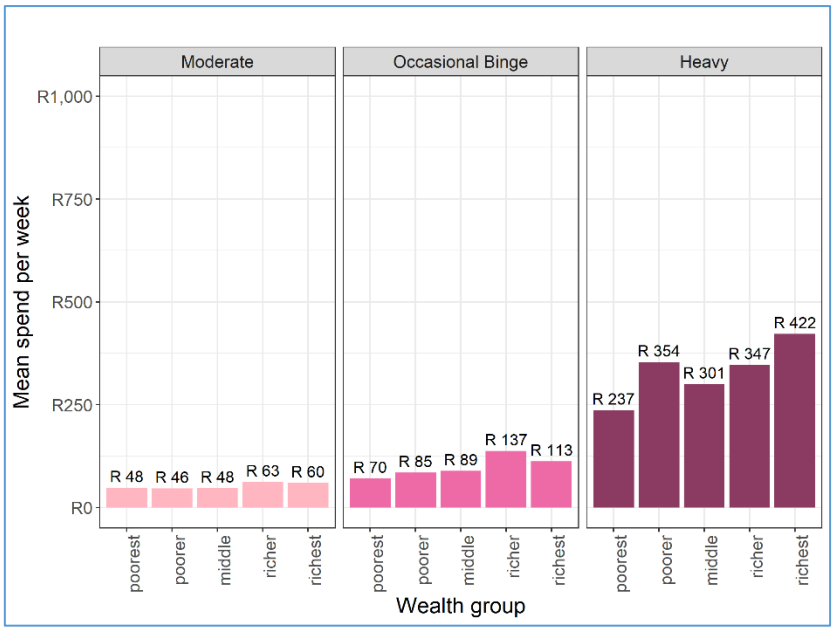
The baseline average weekly drinking and expenditure before the policy is introduced is seen here (Figures 7 and 8).

Figure 7: Baseline average weekly number of standard drinks by drinker and wealth group



[3] A price elasticity indicates the percentage change in consumption following a percentage change in price. The negative sign indicates that as the price increases consumption will decrease. For instance, if the price increases by 1%, a moderate drinker in the poorest group will reduce his consumption by 0.53%.

Figure 8: Baseline weekly expenditure by drinker and wealth group



The prevalence of the diseases and deaths per year for 2018 were estimated using a combination of national and global sources (Table 7) (Appendix part D).

Table 7: Estimated annual burden of disease in the Western Cape in 2018 by sex across six conditions

	Females (age 15+)	**Males (age 15+)**
Estimated population	2,596,366	2,440,205
Deaths		
HIV	1,643	1,756
Tuberculosis	544	1,104
Intentional injury	477	2,180
Road injury	312	974
Liver cirrhosis	136	201
Breast cancer	824	20
Prevalence		
HIV	283,957	153,042
Tuberculosis	709,892	382,605
Intentional injury	124,204	99,746
Road injury	42,871	45,003
Liver cirrhosis	5,050	4,903
Breast cancer	10,289	194

3.5. Results

Consumption estimates

We estimate a mean reduction in overall consumption of 1.9% following an R8 MUP. Exploring the impact for different groups shows a reduction in consumption of around 0.3 standard drinks per week

for moderate drinkers and around 0.5 to 1 standard drinks per week for heavy drinkers (Figure 9). If we look at these impacts in relative terms to average consumption, we see that the moderate drinkers are more impacted than the heavy drinkers in percentage terms as they are more responsive to the price increase (Figure 10).

Figure 9: Estimated impact of R8 MUP on average weekly drinks

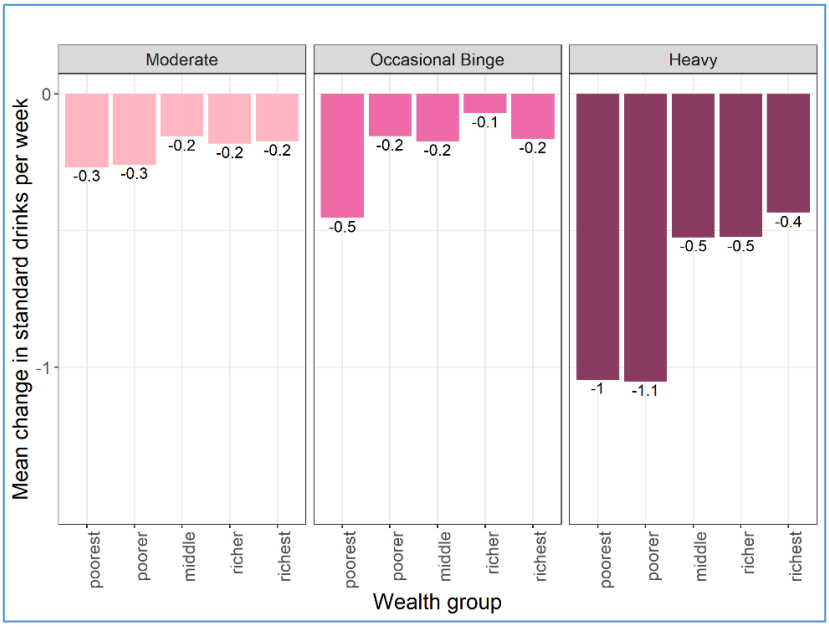
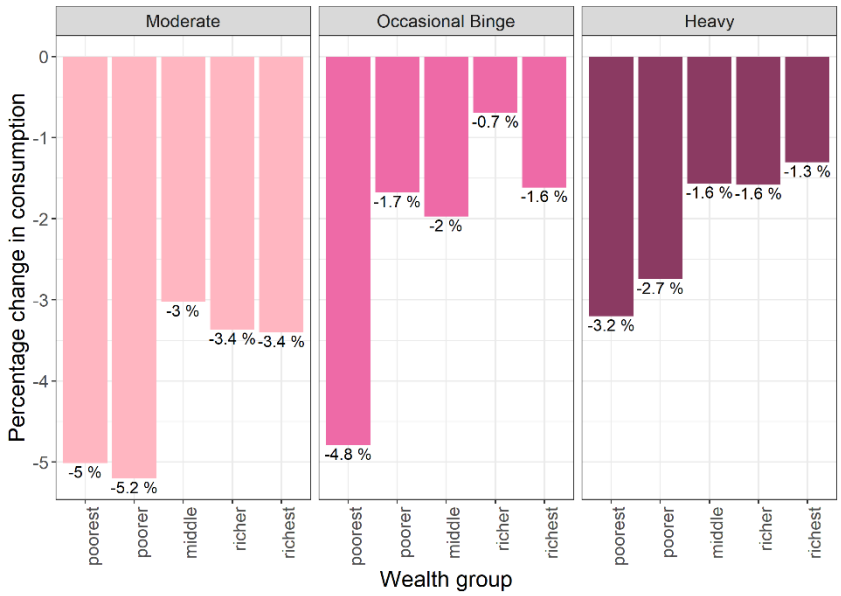


Figure 10: Estimated percentage change in consumption following R8 MUP



Expenditure estimates

We estimate a mean increase in individual alcohol expenditure of 8.7%, but this varies substantially between different drinker and wealth group (see Figure 11). In absolute terms, moderate drinkers are expected to increase their weekly alcohol expenditure by between R2 and R5, depending on income group (see Figure 12). Occasional binge drinkers are expected to increase their weekly alcohol expenditure by between R4 and R9, while heavy drinkers are expected to increase their expenditure by between R27 and R34. The increase in expenditure is greater for heavy drinkers than moderate drinkers in both absolute and percentage terms as they have a lower price elasticity in our model, making them less willing to reduce consumption.

Figure 11: Estimated impact of R8 MUP on average weekly expenditure on alcohol

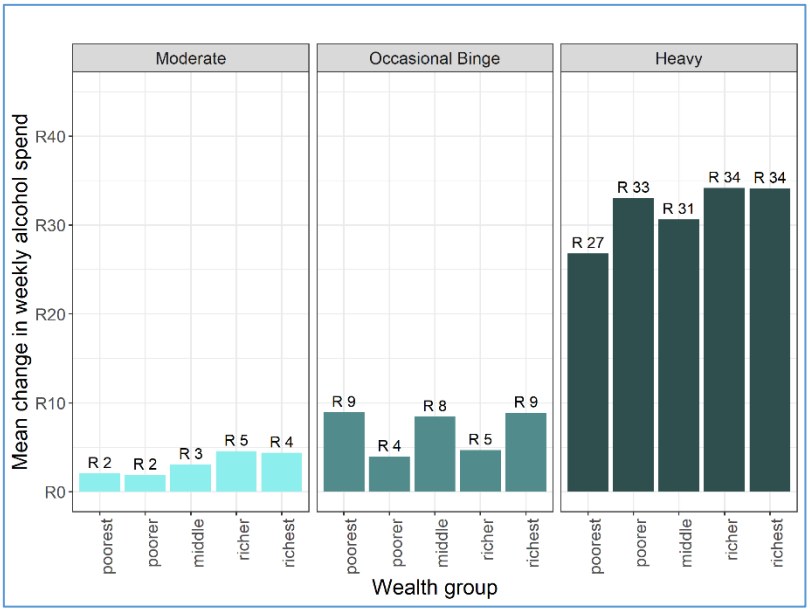
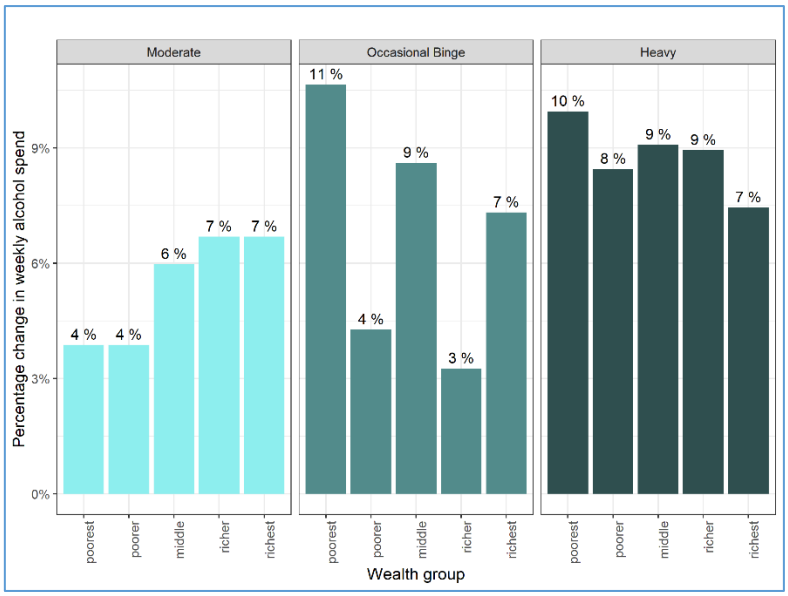


Figure 12: Estimated percentage change in expenditure following R8 MUP



We compare the three policy levels for their impact on consumption and alcohol expenditure (Table 8). Choosing the most appropriate level is a political decision that balances increased costs to consumers with the increased health benefits. The primary scenario used in this report is R8, as this has been indicated to be the most popular with local decision-makers.

Table 8: Comparing levels for impact on consumption and expenditure

	R5	**R8**	**R12**
Consumption reduction	0.2%	1.9%	6.6%
Annual increase in alcohol expenditure (million)	R296	R2,717	R8,689

Health estimates

We estimate that, in the event of no new policy, and all else remaining equal, the Western Cape Province will experience 49,000 deaths and 9,703,000 cases, of the six health conditions included in this study, in the next 20 years that are attributable to alcohol consumption (rounded to the nearest 1,000).

With an R8 MUP, we estimate 942 deaths averted (50/3,000 for R5/R12 respectively) and 273,000 cases averted (17,000/906,000 for R5/R12 respectively) over 20 years (Table 9). We can see how this is distributed throughout the wealth/drinker groups and by disease type (Figure 13 & 14). By far the

biggest impact is on TB, which would be responsible for 91% of cases averted. This is driven by the fact TB accounts for 60% of the cases of disease amongst women and 56% amongst men at baseline, and that it has a steep relative risk curve (Shield et al., 2020) (Appendix E). TB is linked to alcohol use via: lowering the immune system increasing susceptibility to TB; social pathways linking heavy alcohol use and TB; reduced effectiveness of medicines used in the treatment of TB (Rehm et al. 2009). As the wealth groups are not equally-sized quintiles, we also present a graph showing rates of cases averted per 1000 people. This helps to demonstrate that the poorer groups gain proportionally more of the health benefit, particularly in the case of heavy drinkers (Figure 14).

Table 9: Headline deaths and cases averted over 20 years for all three MUP policy scenarios

	R5	**R8**	**R12**
Deaths averted	50	942	3,000
Cases averted	17,000	273,000	906,000
Six conditions include: HIV, intentional injury, road injury, TB, liver cirrhosis, breast cancer			

Figure 13: Cases averted over 20 years by wealth and drinker group, split by health condition, for an MUP of R8 per unit

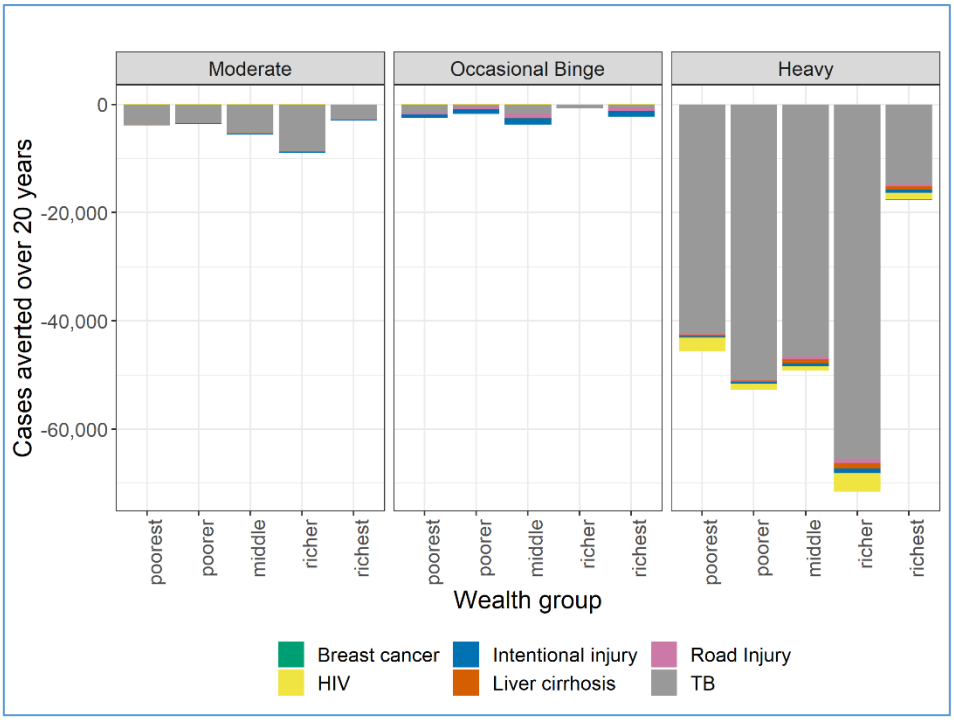
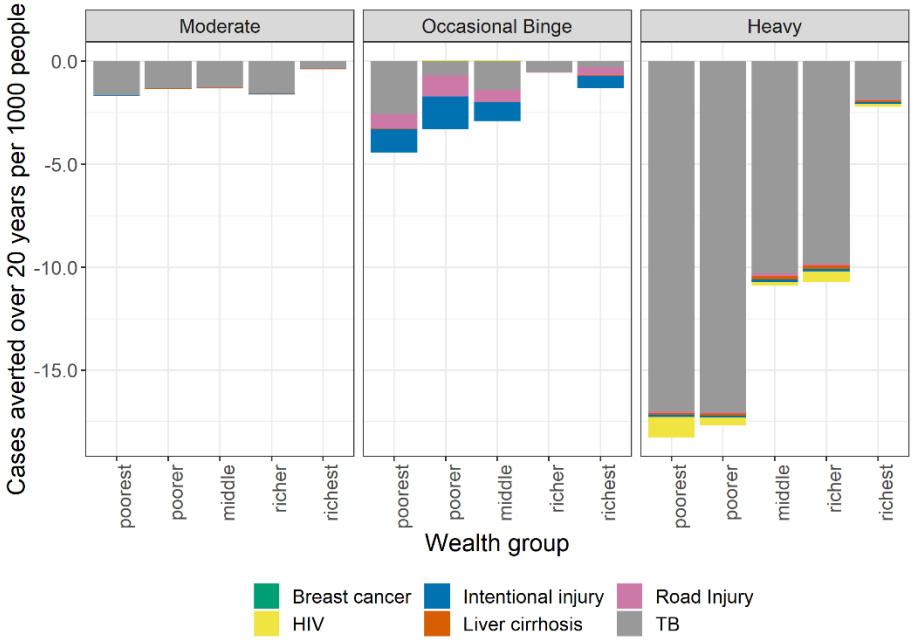


Figure 14: Cases averted per 1000 by wealth and drinker group, split by health condition, for an MUP of R8 per unit



Cost estimates

We estimated costs across healthcare, tax, retail, and crime (Table 10). Healthcare cost savings are estimated by multiplying the number of cases saved as a result of the policy by the proportion we would expect to receive healthcare and the associated cost. The proportion of patients receiving healthcare for the condition varies. We estimated the following proportions: HIV 62%, intentional injury 41%, road injury 19%, liver cirrhosis 50%, breast cancer 50%, and TB 50% (Appendix part F).

We estimated that the total value of VAT collected from alcohol would increase as a result of the policy because the final retail price would increase. As was the case in the UCT model, the excise taxation would decrease as the volume of alcohol consumed would be reduced. The net change is an increase in taxation revenue. The increase in total alcohol-related tax revenue is somewhat higher than that predicted by the UCT model. We also estimated the change in retail revenue. (Appendix part G).

Crime costs are calculated by firstly assuming that a percentage of the Western Cape GDP is spent on the costs of crime. We then used alcohol-attributable fractions from the literature to allocate how much of those costs are incurred because of alcohol. We next assumed that the percentage reduction in consumption relates to an exact percentage reduction in alcohol-attributable crime costs, calculated for each policy scenario (i.e., MUPs of R5, R8 and R12 per unit respectively. (Appendix part H).

Table 10: Estimated healthcare cost savings, crime cost savings, tax revenue and retail revenue for MUP of R5, and R8 and R12

	R5	R8	R12
Healthcare cost savings estimated over 20 years, discounted at 5%, Rand thousand (000)			
Breast cancer	R75	R547	R1,783
HIV	-R47	R11,701	R29,949
Intentional Injury	R3,857	R85,487	R370,152
Liver Cirrhosis	R252	R2,748	R8,839
Road Injury	R2,033	R43,029	R179,398
TB	R22,964	R359,951	R1,190,269
Crime cost savings estimated on an annual basis, Rand thousand (000)[4]			
Correction services	R2,470	R28,123	R96,584
Police and public security	R4,410	R50,221	R172,472
Justice	R86	R974	R3,345

[4] These are all national competencies and do not impact on Western Cape provincial budget, whereas all the health savings impact on Western Cape Government budget

Tax and retail revenue estimated on an annual basis, Rand million (000,000)			
Change in VAT	R39	R354	R1,133
Change in Excise Tax	-R8	-R91	-R313
Net taxation impact	R31	R263	R820
Change in retail revenue	R265	R2,454	R7,868

Comparing MUP levels

In order to assist decision makers looking for the optimal level at which to set an MUP, we compared the outputs of the model for MUP levels of R5, R8 and R12. Table 9 provides total figures for deaths and cases averted at the three levels. We have also estimated how these are distributed between the drinker and wealth groups, first in absolute numbers (Figure 15) and then as a rate in order to take account of the very unequally sized wealth groups (Figure 16).

Figure 15: Comparison of cases averted by MUP level

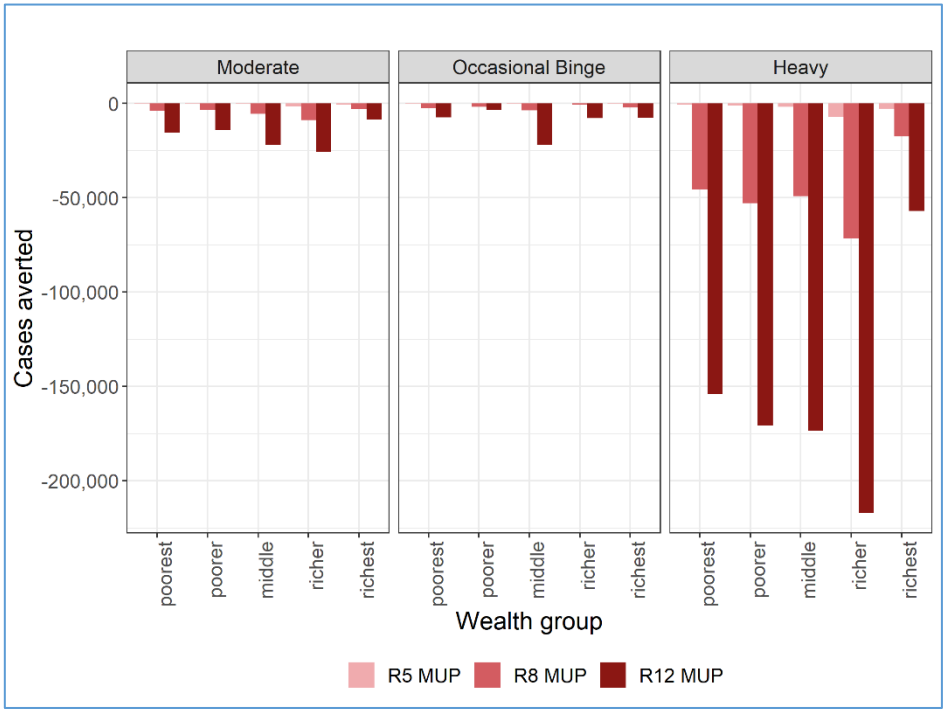
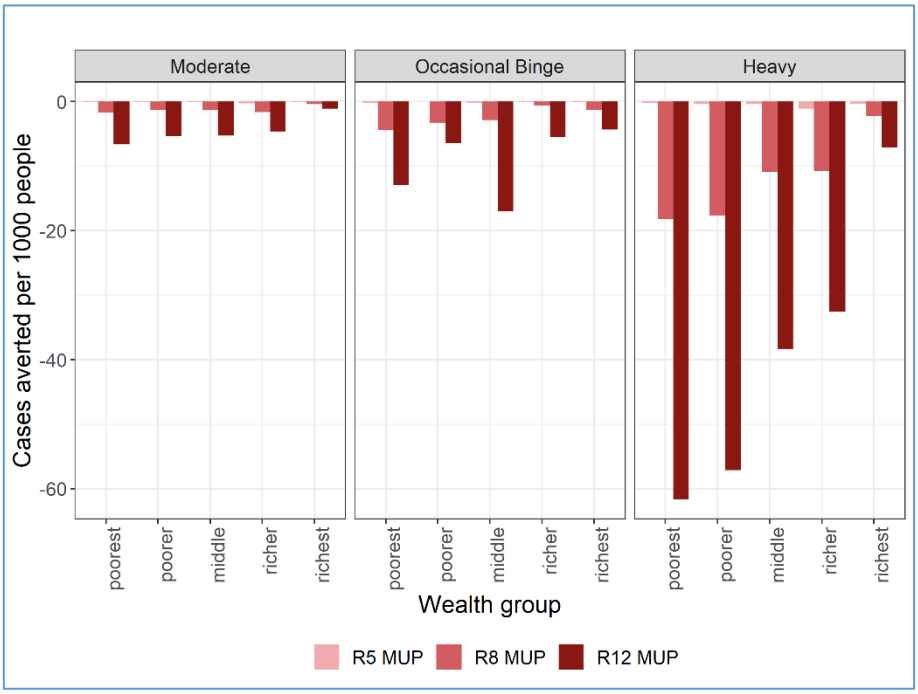


Figure 16: Comparison of cases averted per 1,000 people by MUP level



Sensitivity analysis

Our sensitivity analysis demonstrates the impact of price elasticities on the model estimates. We applied elasticities of -0.18, -0.22 and -0.40 to heavy, occasional binge, and moderate drinkers respectively, with no wealth gradient for an MUP of R8. We see that not applying a wealth gradient results in a slightly greater consumption estimate and smaller increase in expenditure (Table 11). In the base case, we applied a lower elasticity to quintiles 3 – 5, which represent a much greater share of the population and on which therefore the impact is slightly smaller. We see that the total number of deaths averted has increased but the number of cases averted has decreased. As so many of the cases averted are TB cases, a health condition concentrated in Q1 and Q2, reducing their price elasticity lowers results overall.

Table 11: Comparing headline estimates using different elasticities for a R8 MUP

	Change in consumption	Change in expenditure	Total deaths averted	Total cases averted
Elasticities by drinker and wealth group	1.9%	8.7%	942	273,000

Elasticities just by drinker group	2.1%	8.4%	1,092	236,745

We have reproduced Figure 11 to provide a visual comparison of the wealth gradients in health outcomes (Appendix part I). In the base case (i.e. when the price elasticities differ by income group) the poor realise larger health benefits than if the price elasticities of demand are the same across all income groups. The international literature (e.g. Wagenaar et al., 2009) suggests that the base case assumptions are more realistic than the assumption that all income groups have the same price elasticity of demand for alcohol.

3.6. Conclusion

This modelling for the Western Cape has estimated that introducing a MUP in the Western Cape would reduce alcohol consumption, improve health, and reduce healthcare and crime costs.

A key component of the MUP policy is that the increased revenue is kept by the industry, broadly construed. The additional revenue will be shared between the various components along the supply chain, i.e., manufacturers, wholesalers and retailers. We have not estimated how these additional revenues will accrue to the various groups in the supply chain, but it seems likely that the more powerful and concentrated industries are likely to capture a larger proportion of the additional revenue. The design of the MUP is such that the government will not benefit financially from an MUP (other than reductions in alcohol-related costs) but nevertheless it is expected to see a net increase in revenue via taxation, specifically VAT. Rather than calculating unit values based on expenditure and consumption data (as was the case for the UCT model), this study is based on actual price data, as reported by respondents. However, the sample was fairly small (around 800 observations) and the stakeholders involved in the original model development process believed that the alcohol prices might be too high. Therefore, in section 4 we will look at using a matrix of prices (for the baseline and each policy scenario) provided by Van Walbeek and Chelwa as alternative price inputs to the model and see how these impact the results. These prices, derived from NIDS wave 4 and adjusted for inflation, are substantially lower than the prices used in this analysis. We would therefore expect an MUP to have a greater impact on reducing alcohol consumption and its associated harm, as prices would rise more when the MUP was introduced.

4. CHOOSING THE MUP LEVEL

4.1. Illustrative prices of alcohol for different MUP levels

Should an MUP be charged per standard unit of alcohol (also referred to as a standard drink), the formula for the retail price is the following:

Retail Price = {(Volume (ml) x (ABV%/100)/15)} x MUP

Where ABV% is the alcohol by volume percentage, and MUP is the minimum unit price per standard drink (i.e. 15 ml of pure alcohol).

The part of the formula in curly parentheses calculates the number of standard drinks for a given volume of beverage. For example, a 750 ml bottle of whiskey, with 43% ABV, contains 750 x (43/100)/15 = 21.5 standard drinks. A 5-litre box of wine, with 13% ABV, contains 5000 x (13/100)/15 = 43.33 standard drinks. A six-pack of beers (each 440 ml, with 5.5% ABV) contains 6 x 440 x (5.5/100)/15 = 9.68 standard drinks.

The number of standard drinks is then multiplied by the amount of the MUP per standard drink to calculate the retail price at which that volume of beverage would have to be sold.

In Table 12 we present illustrative minimum retail prices for different levels of the MUP. For any beverage category and packaging type, the minimum retail price is a linear function of the MUP value. Thus, the minimum retail price when the MUP is R8.00 per unit is double that when the MUP is R4.00 per unit, and the minimum retail price when the MUP is R10.00 per unit is double that when the MUP is R5.00 per unit.

For comparative purposes, we also show the lowest price for the product. This lowest price is based on data collected by SSA during 2020 and 2021. This does not suggest that cheaper product than this cannot be found, but rather that this is the cheapest price that was collected by SSA. The lowest prices shown in the table will give an idea at which level of the MUP it will become effective for that type of product.

Table 12: Illustrative minimum retail prices for different products and packaging types, for different MUPs

Category	Typical ABV%	Packaging	Lowest price (2020/21)	MUP = R5	MUP = R6	MUP = R8	MUP = R10	MUP = R12	MUP = R15
Brandy	43%	750 ml	R135.00	R107.50	R129.00	R172.00	R215.00	R258.00	R322.50
Whiskey	43%	750 ml	R115.00	R107.50	R129.00	R172.00	R215.00	R258.00	R322.50
Beer	5%	6 x 330 ml	R70.00	R33.00	R39.60	R52.80	R66.00	R79.20	R99.00
Beer	5.5%	750 ml	R16.50	R13.750	R16.50	R22.00	R27.50	R33.00	R41.25
Wine	13%	750 ml	R45.00	R32.50	R39.00	R52.00	R65.00	R78.00	R97.50
Wine	11.5%	3 litre	R100.00	R106.64	R127.96	R170.62	R213.27	R255.93	R319.91
Wine	11.5%	5 litre	R135.00	R177.73	R213.27	R284.36	R355.45	R426.55	R533.18
Cider	5%	6 x 330 ml	R79.00	R33.00	R39.60	R52.80	R66.00	R79.20	R99.00
Spirit cooler	4.5%	6 x 275 ml		R24.75	R29.70	R39.60	R49.50	R59.40	R74.25

4.2. How different alcohol categories and products would be affected by an MUP

In order to appreciate how the imposition of an MUP would affect the retail prices of different alcohol products practically, we used retail data collected by Statistics South Africa, and estimated how many of the monitored prices would be affected by the MUP, at the various possible levels of MUP. The details of the data, and the methodology, are described in Appendix J The data collected by Statistics South Africa are typically for alcohol products sold for off-premise consumption at formal retail outlets. They do not include very low-priced products that are typically sold through informal channels. As such the results should not be regarded as being completely representative of the drinking patterns of all categories of drinkers, and especially not of heavy drinkers, who typically drink very cheap alcohol. However, it provides an imperfect indication of how an MUP may impact certain categories. We are currently collecting alcohol prices in informal outlets in Cape Town and smaller towns during the July 2021 vacation, and we will use these to supplement this analysis.

Table 13 indicates what percentage of the different line items, as captured by Statistics South Africa, are affected by the MUP at various levels. It is important to note that the data do not give us any indication of the volumes sold at these prices and therefore the percentages need to be interpreted with care, as they only capture the number of observed records of prices. If the MUP is set at R4.00 per standard drink, it would have no impact on any of the alcohol categories, other than wine.[5] For wine, 3% of the prices recorded are affected. These are either 5-litre or 3-litre "box wines" (not shown here). If the MUP is increased to R5.00 per standard unit, a larger percentage of wines are affected. These are

[5] Since Statistics South Africa does not capture the prices of ales and other sugar-fermented beverages, these are not shown here. However, as pointed out previously, these products are often sold at extremely low prices, and would most definitely be affected by an MUP, even as low as R4.00 per standard drink.

mostly the 3-litre and 5-litre "box wines", but also some 2 litre and 1.5-litre bottles. A small percentage of vodka, in the standard 750 ml bottle, is also affected if the MUP is set at R5.00 per unit.

If the MUP is set at R6.00 per standard unit, this will have an impact on brandy (10% of line items), vodka (21%), whiskey (4%) and wine (11%). For the three categories of spirits, the MUP would affect the 750 ml bottles. For wine, the impact will still be mostly on the larger containers, but some 750 ml bottles would be affected as well.[6]

If the MUP is set at R7.00 per standard drink, a total of 16% of recorded prices will be affected. Nearly half of vodka prices would be affected, 39% of brandy prices, 20% of whiskey prices and 15% of wine prices. At this level of the MUP, about 5% of beer prices would be affected. These are mostly for beers sold in either 1 litre or 750 ml containers, or in six-packs (Statistics SA does not collect data on multipacks greater than 6 units). Furthermore, the beers that are most affected are the ones with higher alcoholic content (5.5%), although some beers with 5% or even 4.5% alcohol content would be affected as well.

If the MUP is raised to higher levels, it will affect a greater proportion of the items monitored by Statistics South Africa. However, the effect of the higher MUP differs across the various alcohol categories. For example, if the MUP is set at R10.00 per standard drink, nearly all brandy will be affected, and nearly 80% of vodka, but only two-thirds of whiskey prices, half of wine prices, and a third of beer prices. Liqueurs would not be affected by an MUP of R10.00. Only a modest percentage of the recorded prices of "spirit coolers or ciders" would be affected by an MUP of R10.00.

Table 13: Percentage of Statistics South Africa-monitored records affected by an MUP at various levels

MUP per standard unit	Beer	Brandy	Liqueur	Spirit cooler or cider	Vodka	Whiskey	Wine	Total
4	0%	0%	0%	0%	0%	0%	3%	1%
5	0%	0%	0%	0%	1%	0%	9%	2%
6	0%	10%	0%	0%	21%	4%	11%	6%
7	5%	39%	0%	1%	48%	20%	15%	16%
8	14%	72%	0%	1%	70%	36%	26%	28%
9	24%	89%	0%	1%	77%	52%	39%	39%
10	33%	96%	0%	4%	79%	67%	49%	48%
11	44%	98%	3%	5%	83%	79%	58%	56%
12	57%	100%	7%	7%	87%	87%	66%	64%

[6] It seems likely that the percentage of wines affected by an MUP set at R6.00 per unit could be substantially higher than 11%. In an interview with Laurine Platzky, one of the editors of this report, SAWIS reported that about 80% of wine consumed in South Africa, is sold at R30 or less per 750%. A bottle of wine (at 12% ABV) contains 6 standard units of alcohol. If the MUP is set at R6.00 per unit, this would equate to R36.00 per bottle, which means that at least 80% of wine consumed in South Africa would be affected by the MUP.

13	65%	100%	11%	14%	90%	90%	75%	70%
14	75%	100%	17%	23%	92%	92%	80%	75%
15	83%	100%	28%	40%	93%	95%	83%	81%

In Table 14 we indicate the average percentage change in the retail price that would be required to move the retail price of the affected records to the MUP level. This table should be read in conjunction with Table 13 because the average price change only applies to the percentage of records where the MUP has an effect.

Table 14: Average percentage change in the retail price if an MUP is imposed (on affected products only)

MUP	Beer	Brandy	Liqueur	Spirit cooler or cider	Vodka	Whiskey	Wine	Total
4							7.9	7.9
5		3.5			2.0	1.6	19.0	18.2
6	2.9	8.2			9.3	7.6	35.9	21.7
7	7.4	12.7		4.3	16.6	12.4	46.3	21.3
8	12.1	19.3		19.2	25.4	18.9	41.3	24.4
9	17.2	29.3		19.6	38.0	25.1	41.5	30.5
10	23.7	41.0	2.0	17.3	52.3	31.4	46.3	38.0
11	27.8	53.7	4.2	23.9	64.3	38.6	52.6	44.8
12	31.5	66.7	8.4	24.5	76.0	46.8	58.7	51.1
13	37.8	80.5	12.5	20.7	87.4	57.1	64.3	58.8
14	42.6	94.4	14.7	19.1	99.9	68.3	72.1	66.2
15	47.8	108.3	15.2	17.0	112.6	77.5	81.2	72.9

In general, the higher the MUP, the greater will be the average increase in the price of the affected products.

4.3. Conclusion and recommendations

The decision about the level of the MUP will need to be taken by the Western Cape Government. This analysis has shown that the higher the MUP is set, the more categories of alcohol are affected, but the effect differs from one category to the next. We recommend the following:

1. Should the Western Cape government implement an MUP, it should set the level as high as economically and politically feasible. This is a pragmatic approach, recognising the power of the wine and brandy lobby in the Western Cape, yet taking the improvement of public health and safety seriously as has been articulated by the governing party.

2. It should not differentiate the tax by different categories of alcohol.[7]

3. The MUP should be increased on a regular (and predictable - annual) basis, to prevent a situation in which inflation erodes the real value of the MUP and makes the policy impotent.

[7] Sorghum beer was not investigated in this study, and therefore we do not express an opinion about it. However, based on Treasury's excise revenue data, the sorghum beer industry is a sunset industry. The product is consumed by a rapidly aging population and seems to "dying out".

5. CONCLUSION

5.1. MUP consumption and health impacts

The UCT model estimated that a province-specific MUP would substantially reduce alcohol consumption in the Western Cape, especially among regular heavy drinkers, but also among occasional heavy drinkers and intermediate drinkers. The NIDS data which are the basis of the analysis indicates that heavy drinkers in the Western Cape consume very cheap alcohol; this pattern is supported by the international literature (Wagenaar et al., 2009).

The Sheffield model estimates that 942 lives are saved and 273,000 cases of six alcohol-related conditions (HIV, TB, road injury, intentional injury, liver cirrhosis, and breast cancer) are prevented over a 20-year period if the MUP is set at R8 per standard unit. The model suggests that the greatest health benefits will accrue to the poorest groups, particularly amongst the heaviest drinkers.

5.2. Comparing the University of Cape Town and Sheffield Models

This report has presented two different approaches to modelling the impact of Minimum Unit Pricing on alcohol for the Western Cape, based on previously published models for South Africa (Van Walbeek and Chelwa, 2021, Gibbs et al., 2021). The models both show that an MUP would be effective in reducing consumption of alcohol and improving health; however, they do not align on the magnitude of this effect or on the relative impact by drinker group. The UCT model suggests that the impact will be far greater for heavy drinkers in relative as well as absolute terms. The Sheffield model (Gibbs et al., 2021) suggests that although the absolute reduction will be greatest for heavy drinkers, in percentage terms they are the least impacted.

Both models use very similar elasticities to drive the policy impact but there are two differences, one of data and one of methods, which are responsible for the different estimates of the impact of the MUP. The first and most important is the pricing data used in the model. The UCT model uses the National Income Dynamic Study (NIDS) to estimate prices by taking a monthly estimate of alcohol expenditure and dividing it by a monthly estimate of consumption generated through quantity/frequency questions. These values are self-reported by respondents to the NIDS questionnaires. As we pointed out, it seems plausible that heavy drinkers have systematically understated their expenditure on alcohol. If they have understated their expenditure by a greater proportion than their consumption, the unit values will be understated as well. The reported unit values are substantially lower that the retail prices of alcohol sold

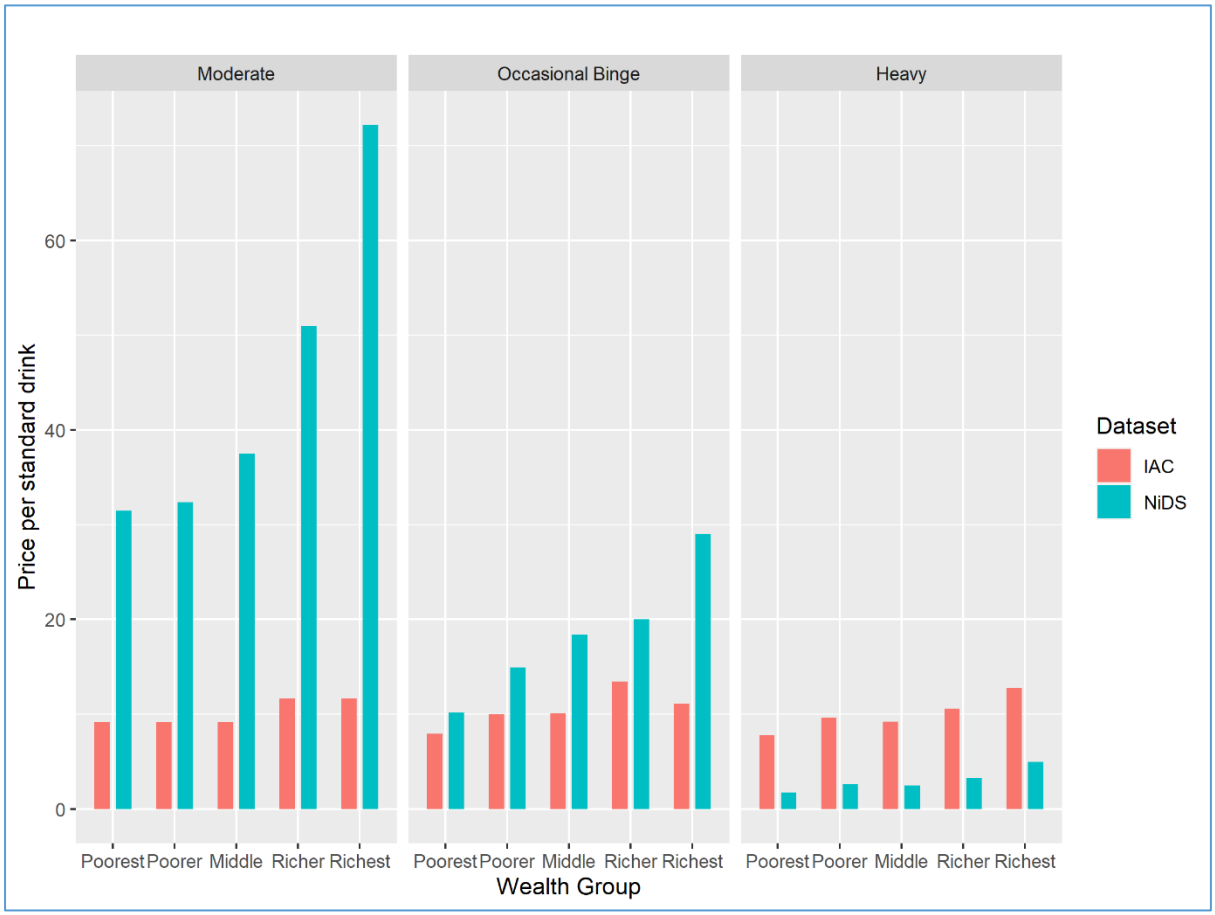
in formal retail outlets (as monitored by SSA) and alcohol sold in informal outlets (through a REEP survey).

The Sheffield model uses price distributions for wealth and drinker groups using actual price data linked to individual drinking from the International Alcohol Control Study (IAC) survey 2014/2015 completed in the metropolitan district of Tshwane. The IAC asked for highly detailed data about prices in both on- and off-trade locations and took into account container size, drink type, and number of drinks purchased. We can see the difference in the estimated baseline prices between the two datasets (Table 15, Figure 17). Grieve Chelwa provided the NIDS prices, which use income quintiles to proxy wealth quintiles owing to data constraints. The NIDS prices are far lower for heavy drinkers than the IAC prices, while the moderate drinkers, and to some extent binge drinkers, report far higher prices in the calibrated IAC data. In summary, the NIDS prices suggest a far bigger differential between the prices paid by drinker type and so are likely to show a much higher differential impact, such that the price elasticities (which are lower for heavier drinkers) are outweighed.

Table 15: Comparing IAC and NIDS estimated price per standard drink

	Moderate	**Occasional Binge**	**Heavy**
IAC prices			
Q1	R9	R8	R8
Q2	R9	R10	R10
Q3	R9	R10	R9
Q4	R12	R13	R11
Q5	R12	R11	R13
NIDS prices			
Q1	R32	R10	R2
Q2	R32	R15	R3
Q3	R38	R18	R3
Q4	R51	R20	R3
Q5	R72	R29	R5
Prices rounded to the nearest Rand IAC prices are calibrated to CPI and SAWIS data NIDs prices computed using drinker categories to match the Sheffield model			

Figure 17: Mean price per standard drink at baseline



The second key difference between the models is the method used to apply the elasticities. There are two methods – the arc/midpoint approach (Parkin, 2019) and the standard econometric approach. The arc method is argued to be more appropriate where price changes are very large and to effectively reduce the impact of these very large changes on consumption. The UCT model features very large price increases for heavy drinkers (e.g., a 200% price increase for a Q1 heavy drinker under a R5 MUP) and so it applies the arc method, whereas the price increases faced by drinkers in the Sheffield model are estimated to be considerably smaller (e.g., a 0.2% average price increase for a Q1 heavy drinker under a R5 MUP) and uses the standard approach. The impact of this difference in the use of the price elasticity formula is to reduce the extent to which alcohol consumption decreases with MUP in the UCT model.

There are additional data and methodological differences, such as the Sheffield model breaking down prices and elasticities and consumption by wealth as well as by drinker group, as this links with baseline harm essential for the epidemiological part of the model, which will not be expanded on here. We also draw our underlying consumption estimates from different datasets.

Table 16: Price elasticities applied in the model

	Q1	Q2	Q3	Q4	Q5
Sheffield Model					
Moderate	-0.53	-0.53	-0.31	-0.31	-0.31
Occasional binge	-0.29	-0.29	-0.17	-0.17	-0.17
Heavy	-0.24	-0.24	-0.14	-0.14	-0.14
UCT Model					
Moderate	-0.45	.45	.45	.45	.45
Intermediate	-0.35	-0.35	-0.35	-0.35	-0.35
Occasional binge	-0.22	-0.22	-0.22	-0.22	-0.22
Heavy	-0.18	-0.18	-0.18	-0.18	-0.18

In order to investigate how much influence the price inputs have on the results, we used the NIDS estimates of baseline prices, generated by Grieve Chelwa (Table 15) and re-ran the Sheffield Model to compare the results.

Comparison of results

As the UCT model focuses on consumption impact, and not harm, this is the focus of our comparison. We compare results for a R5 and an R8 MUP projected for the Western Cape Province only (Table 17). The UCT model gives higher impacts and a more differential effect between drinkers than the Sheffield model. However, when we substitute the NIDS prices into the Sheffield model, the heavy drinkers see a much greater reduction in their consumption, as we would expect. On the other hand, moderate drinkers see very little impact on their consumption as they buy alcohol well above the MUP threshold.

Table 17 also highlights the impact of the arc method as opposed to the point estimate method, with the arc method somewhat decreasing the large impacts. It is also possible to see that the alternative methods increase the difference in results as the level of MUP increases.

Table 17: Comparison of Western Cape results between the UCT Model and the Sheffield Model with IAC prices and with NIDS prices

	Moderate-drinking households	Intermediate drinking households	Occasional heavy drinking households	Regular heavy-drinking households
R5 MUP				
UCT model	-0.6%	-4.6%	-4.4%	-15.7%
Sheffield model	-0.4%	-	-0.2%	-0.1%

Sheffield model using NIDS prices	-0.2%	-	-0.6 %	-16.2%
R8 MUP				
UCT model	-1.8%	-10.0%	-6.7%	-19.8%
Sheffield model	-3.7%	-	-1.7%	-1.8%
Sheffield model using NIDS prices	-0.5%	-	-1.6%	-38.1%

Future direction

It is important to note that both models agree that MUP is an effective policy to reduce alcohol consumption, and therefore harm, in South Africa and, in particular, the Western Cape province. The magnitude of the impact varies and the relative impact between drinker group also varies, but even in the Sheffield model (with IAC prices) the greatest reduction in alcohol consumption in absolute terms accrues to heavy drinkers, who then go on to accrue the greatest health benefits. As the biggest difference between the two models arises from uncertainty around the prices that people pay for alcohol, we would strongly recommend that improved pricing data be collected alongside consumption data, ideally in a way that disaggregates data by age to allow for drinking patterns to be accounted for (especially heavy and binge drinking) so that we can truly understand the differential impact of this policy.

5.3. Choosing the MUP level

The Western Cape government will decide the level at which to set the MUP. The higher the level, the more effective the MUP will be in reducing consumption; however, it also needs to be politically workable. The analysis of CPI data has demonstrated how more categories of alcohol are affected as the threshold rises. We recommend that the level is set as high as economically and politically feasible, but stress that it is essential to set it at the same level across all categories of alcohol. If this is not done, the policy will be ineffective as heavy drinkers will be able to switch their consumption to an alternative beverage. We also recommend that increases to the MUP should be built into the legislation to account, at the least, for inflationary pressures.

5.4. Summary

This report has provided quantitative estimates of the impact of an MUP policy in the Western Cape. The modelling suggests that MUP would reduce alcohol consumption and alcohol-related harm, particularly amongst heaviest drinkers and the poorest groups. The higher the threshold of the MUP the greater the decrease in consumption and consequent health impacts. Further research should prioritise the collection of pricing data. This dataset would need to provide detailed retail prices, coupled with information about the drinking patterns of the purchaser, like the International Alcohol Control Study, but ideally with a larger sample size and specifically carried out in the Western Cape province. Furthermore, the survey should cover all outlets, not only the licenced ones.

Whereas an increase in the excise tax on alcohol products is expected to increase government excise tax revenue, an MUP is not aimed at raising revenue. In the above analysis, the UCT model estimated a limited impact on government revenue with a small increase to government revenue at higher levels of MUP. The Sheffield model estimated an increase for retail revenue and an increase in government revenue, with the increased VAT more than offsetting any loss in excise taxation from the reduction in volume sold.

We would like to highlight that the models have not estimated the reduction in harm to non-drinkers (for example via intimate partner violence and foetal alcohol syndrome) as a result of the reduced consumption. We have only captured a limited number of health harms to the drinker. Therefore, we suggest that this is a lower bound of the beneficial impact of an MUP policy.

6. REFERENCES

(IHME), I. F. H. M. A. E. 2019. *GBD Compare* [Online]. Seattle, WA: IHME, University of Washington. Available: http://vizhub.healthdata.org/gbd-compare [Accessed 26/01/2021 2021].

ALDA, E. & CUESTA, J. 2011. A comprehensive estimation of costs of crime in South Africa and its implications for effective policy making. *Journal of International Development,* 23**,** 926-935.

BARRON, K., BRADSHAW, D., PARRY, C. D., DORRINGTON, R., GROENEWALD, P., LAUBSCHER, R. & MATZOPOULOS, R. 2020. Alcohol and short-run mortality: Evidence from a modern-day prohibition. *Available at SSRN 3744031*.

BLECHER, E. 2015. Taxes on tobacco, alcohol and sugar sweetened beverages: Linkages and lessons learned. *Social Science & Medicine,* 136**,** 175-179.

BOLA, S., DASH, I., NAIDOO, M. & ALDOUS, C. 2016. Interpersonal violence: quantifying the burden of injury in a South African trauma centre. *Emergency medicine journal,* 33**,** 208-212.

BUDLENDER, D. 2009. National and provincial government spending and revenue related to alcohol abuse. *Johannesburg: Soul City*.

DAVIES, M.-A., MODEN, E., MOSIDI, T., ZINYAKATIRA, N. & VALLABHJEE, K. 2020. Burden of disease rapid review update 2019. *In:* GOVERNMENT, W. C. (ed.). Cape Town: Western Cape Government.

DEPARTMENT OF PLANNING MONITORING AND EVALUATION (DPME). 2015. *National Income Dynamics Study: Adult questionnaire* [Online]. Available: www.datafirst.ac.za [Accessed 2021].

GIBBS, N. K., ANGUS, C., DIXON, S., PARRY, C. D. & MEIER, P. S. 2021. Effects of Minimum Unit Pricing for Alcohol in South Africa Across Different Drinker Groups and Wealth Quintiles: A Modelling Study. *BMJ open,* 11.

GOSSAGE, J. P., SNELL, C. L., PARRY, C. D., MARAIS, A.-S., BARNARD, R., DE VRIES, M., BLANKENSHIP, J., SEEDAT, S., HASKEN, J. M. & MAY, P. A. 2014. Alcohol use, working conditions, job benefits, and the legacy of the "Dop" system among farm workers in the Western Cape Province, South Africa: hope despite high levels of risky drinking. *International journal of environmental research and public health,* 11**,** 7406-7424.

GUZHA, N., THEBE, T., BUTLER, N. & VALODIA, P. 2020. Development of a method to determine the cost of breast cancer treatment with chemotherapy at Groote Schuur Hospital, Cape Town, South Africa. *South African Medical Journal,* 110**,** 296-301.

HEALTH SYSTEMS TRUST 2020. District Health Barometer 2018/19.

JOFFE, M., AYENI, O., NORRIS, S. A., MCCORMACK, V. A., RUFF, P., DAS, I., NEUGUT, A. I., JACOBSON, J. S. & CUBASCH, H. 2018. Barriers to early presentation of breast cancer among women in Soweto, South Africa. *PloS one,* 13**,** e0192071.

LASLETT, A.-M., JIANG, H. & ROOM, R. 2021. Minimum unit price deters heaviest alcohol purchasers. *The Lancet Public Health*.

MACHEMEDZE, T., KERR, A. & DORRINGTON, R. 2020. *South African population projection and household survey sample weight recalibration*, United Nations University World Institute for Development Economics Research.

MANYONI, M. J. & ABADER, M. I. 2021. The effects of the COVID-19 lockdown and alcohol restriction on trauma-related emergency department cases in a South African regional hospital. *African Journal of Emergency Medicine,* 11**,** 227-230.

MATZOPOULOS, R. G., PRINSLOO, M., BUTCHART, A., PEDEN, M. M. & LOMBARD, C. J. 2006. Estimating the South African trauma caseload. *International Journal of Injury Control and Safety Promotion,* 13**,** 49-51.

MATZOPOULOS, R. G., TRUEN, S., BOWMAN, B. & CORRIGALL, J. 2014. The cost of harmful alcohol use in South Africa. *South African Medical Journal,* 104**,** 127-132.

MEYER-RATH, G., VAN RENSBURG, C., CHIU, C., LEUNER, R., JAMIESON, L. & COHEN, S. 2019. The per-patient costs of HIV services in South Africa: Systematic review and application in the South African HIV Investment Case. *PloS one,* 14**,** e0210497.

MOHR, P. 2020. *Economics for South African students, 6th edition*, Van Schaik.

NORBERG, J., NILSSON, T., ERIKSSON, A. & HARDCASTLE, T. 2009. The costs of a bullet: inpatient costs of firearm injuries in South Africa. *SAMJ: South African Medical Journal,* 99**,** 442-444.

DEPARTMENT OF NATIONAL TREASURY. Budget Review Report 2021. Republic of South Africa. http://www.treasury.gov.za/documents/national%20budget/2021/review/FullBR.pdf. Accessed 14 August 2021

Richard Gregory Matzopoulos, Sarah Truen, Brett Bowman, Joanne Corrigall (2014). "The cost of harmful alcohol use in South Africa." S Afr Med J 104(2): 127-132.
PARKIN, M. 2019. *Economics. 13th Edition.*, Harlow: Essex, Pearson.
PARKINSON, F., KENT, S., ALDOUS, C., OOSTHUIZEN, G. & CLARKE, D. 2014. The hospital cost of road traffic accidents at a South African regional trauma centre: A micro-costing study. *Injury,* 45**,** 342-345.
PASEK, J. 2018. *anesrake: ANES Raking Implementation* [Online]. R package version 0.80. Available: https://CRAN.R-project.org/package=anesrake [Accessed 2021].
PILLAY-VAN WYK, V., MSEMBURI, W., LAUBSCHER, R., DORRINGTON, R. E., GROENEWALD, P., GLASS, T., NOJILANA, B., JOUBERT, J. D., MATZOPOULOS, R. & PRINSLOO, M. 2016. Mortality trends and differentials in South Africa from 1997 to 2012: second National Burden of Disease Study. *The Lancet Global Health,* 4**,** e642-e653.
POORAN, A., PIETERSON, E., DAVIDS, M., THERON, G. & DHEDA, K. 2013. What is the cost of diagnosis and management of drug resistant tuberculosis in South Africa? *PloS one,* 8**,** e54587.
PRINSLOO, M. (in press). The 2nd Injury Mortality Survey: A national study of injury mortality levels and causes in South Africa in 2017. *In:* COUNCIL, S. A. M. R. (ed.). Cape Town: South African Medical Research Council.
PUBLIC HEALTH SCOTLAND 2020. Evaluating the impact of minimum unit pricing (MUP) on sales-based alcohol consumption in Scotland: Controlled interrupted time series analyses. Scotland.
REHM, J., KEHOE, T., GMEL, G., STINSON, F., GRANT, B. & GMEL, G. 2010. Statistical modeling of volume of alcohol exposure for epidemiological studies of population health: the US example. *Population Health Metrics,* 8**,** 3.
REHM, J., SAMOKHVALOV, A.V., NEUMAN, M.G., ROOM, R., PARRY, C., LÖNNROTH, K., PATRA, J., POZNYAK, V. AND POPOVA, S., 2009. The association between alcohol use, alcohol use disorders and tuberculosis (TB). A systematic review. BMC public health, 9(1), pp.1-12.
REPUBLIC OF SOUTH AFRICA 2012. Guidelines for Pharmacoeconomic Submissions. *In:* DEPARTMENT OF HEALTH (ed.). Government Gazette.
REPUBLIC OF SOUTH AFRICA 2014. A review of the taxation of alcoholic beverages in South Africa. *In:* NATIONAL TREASURY (ed.).
REPUBLIC OF SOUTH AFRICA. 2021. *Budget Review* [Online]. Available: http://www.treasury.gov.za/documents/national%20budget/2021/review/FullBR.pdf [Accessed September 2021].
RUSSELL, C. & VAN WALBEEK, C. 2016. How does a change in the excise tax on beer impact beer retail prices in South Africa? *South African Journal of Economics,* 84**,** 555-573.
SHIELD, K., MANTHEY, J., RYLETT, M., PROBST, C., WETTLAUFER, A., PARRY, C. D. & REHM, J. 2020. National, regional, and global burdens of disease from 2000 to 2016 attributable to alcohol use: a comparative risk assessment study. *The Lancet Public Health,* 5**,** e51-e61.
STATISITCS SOUTH AFRICA 2020. Mortality and causes of death in South Africa, 2017: Findings from death notification. *In:* AFRICA, S. S. (ed.). Pretoria: Statistics South Africa.
STATISTICS SOUTH AFRICA. 2018. *Four facts about our provincial economies* [Online]. Available: http://www.statssa.gov.za/?p=12056 [Accessed 23/06/2021 2021].
TAYLOR, N., MILLER, P., COOMBER, K., LIVINGSTON, M., SCOTT, D., BUYKX, P. & CHIKRITZHS, T. 2021. The impact of a minimum unit price on wholesale alcohol supply trends in the Northern Territory, Australia. *Australian and New Zealand Journal of Public Health,* 45**,** 26-33.
UNAIDS. 2020. *UNAIDS South Africa: Overview* [Online]. online. Available: https://www.unaids.org/en/regionscountries/countries/southafrica [Accessed 27/02/2020].
VAN WALBEEK, C. & BLECHER, E. 2014. *The economics of alcohol use, misuse and policy in South Africa* [Online]. South Africa: WHO South Africa Office. Available: http://www.tobaccoecon.uct.ac.za/sites/default/files/image_tool/images/405/People/the-economics-of-alcohol-policy-in-south-africa.pdf [Accessed 10/03/2019].
VAN WALBEEK, C. & CHELWA, G. 2018. Using price-based interventions to reduce abusive drinking in the Western Cape province: a report for the DG Murray Trust. University of Cape Town.
VAN WALBEEK, C. & CHELWA, G. 2019. Using price-based interventions to reduce abusive drinking in the Western Cape Province.
VAN WALBEEK, C. & CHELWA, G. 2021. The case for minimum unit prices on alcohol in South Africa. *South African Medical Journal,* 111**,** 680-684.
VELLIOS, N. & VAN WALBEEK, C. 2018. Self-reported alcohol use and binge drinking in South Africa: Evidence from the National Income Dynamics Study, 2014-2015. *South African Medical Journal,* 108**,** 33-39.
VENTO, S., DZUDZOR, B., CAINELLI, F. & TACHI, K. 2018. Liver cirrhosis in sub-Saharan Africa: neglected, yet important. *The Lancet Global Health,* 6**,** e1060-e1061.

WAGENAAR, A. C., SALOIS, M. J. & KOMRO, K. A. 2009. Effects of beverage alcohol price and tax levels on drinking: a meta-analysis of 1003 estimates from 112 studies. *Addiction,* 104**,** 179-190.
WESSON, H. K., BOIKHUTSO, N., HYDER, A. A., BERTRAM, M. & HOFMAN, K. J. 2016. Informing road traffic intervention choices in South Africa: the role of economic evaluations. *Global health action,* 9**,** 30728.
WHO AND WORLD ECONOMIC FORUM. 2011. *From Burden to "Best Buys": Reducing the Economic Impact of Non-Communicable Diseases* [Online]. Available: http://www.who.int/nmh/publications/best_buys_summary.pdf [Accessed 2021].
WORLD HEALTH ORGANISATION. 2018. *Global status report on alcohol and health* [Online]. Geneva: WHO. Available: https://www.who.int/substance_abuse/publications/global_alcohol_report/en/ [Accessed 29/03/2019].
WORLD HEALTH ORGANISATION 2021 forthcoming. WHO Technical manual on alcohol tax and price policies (forthcoming).

APPENDICES

A. Exploratory data analysis

SADHS data were used for the model; however, as it did not provide a large enough sample for us to use only Western Cape observations, it was reweighted using proportions from the NIDS survey to get provincial estimates. The difference between the nation as a whole and the Western Cape was interrogated in the NIDS data using a combination of summary data tables and regressions. The summary data clearly showed that the Western Cape differed in a number of ways. It has a very different distribution across population groups, fewer classified as African Black and more as Coloured, and crucially it had a higher prevalence of drinking.

We ran probit regressions to explore whether being a drinker was dependent on being in the Western Cape. There was no evidence that being in the Western Cape was correlated with whether or not an individual drinks beyond what could be accounted for by age, sex, income, population group, and urban/rural habitation. It appeared from some exploratory regressions that being in the Western Cape might be significant for how much a drinker drinks, but the absolute amount was very small. The amount of alcohol drunk was checked before and after the reweighting process and it moved in the same direction and was of a similar magnitude (see standard drinks per year, Table B1).

B. Reweighting using raking

In order to reweight the SADHS data to represent the Western Cape we used the "anesrake" package in R, which implements the American National Election Study weighting algorithm (Pasek, 2018). The algorithm uses an iterative process to generate multiplicative weights.

First, proportions of the NIDS survey (for Western Cape only) were calculated for population groups (0.30/0.46/0.01/0.23 for Black African/Coloured/Asian/White respectively), drinking prevalence (0.45/0.55 drinker/non-drinker) and sex (0.54/0.46 female/male). Anesrake then chooses weights such that our SADHS proportions agree with the NIDS Western Cape proportions for these parameters. The raking algorithm provided stable results. The new weights provide the proportions reported in the table below and have been checked to ensure face validity (Table 1).

Appendix Table B1: Summary data for reweighting SADHS to represent the Western Cape using NIDS proportions

		National Income Dynamic Study (NIDS)		South African Demographic and Health Survey (SADHS)	
		National proportions using survey weights (count)	Western Cape only using survey weights	National proportions using original survey weights (count)	New proportions following reweighting
Sex	Females	0.53 (13,284)	0.54	0.59 (6126)	0.54
	Males	0.47 (9456)	0.46	0.41 (4210)	0.46
Province	Western Cape	0.12	-	0.11	-
	Eastern Cape	0.12		0.12	
	Northern Cape	0.02		0.02	
	Free State	0.05		0.05	
	KwaZulu-Natal	0.19		0.18	
	North West	0.07		0.07	
	Gauteng	0.25		0.27	
	Mpumalanga	0.08		0.08	
	Limpopo	0.10		0.10	
Geographical setting **(for SADHS the categories are urban/rural)**	*NIDS*				
	Traditional	0.32	0		
	Urban	0.63	0.94		
	Farms	0.05	0.06		
	SADHS				
	Urban			0.665	0.84
	Rural			0.335	0.16
Population Group	Black African	0.80	0.30	0.84	0.31
	Coloured	0.09	0.46	0.08	0.47
	Indian/Asian	0.03	0.01	0.02	0.01
	White	0.09	0.23	0.06	0.22
	Other	0	0	0	0
Drinker	Yes	0.33	0.45	0.33	0.45
	No	0.67	0.55	0.67	0.55
Drinker (men only)	Yes	0.48	0.54	0.52	0.59
	No	0.52	0.46	0.48	0.41

Drinker (women only)	Yes No	0.20 0.80	0.37 0.63	0.18 0.82	0.32 0.68
Wealth groups	Q1 Q2 Q3 Q4 Q5	-	-	0.19 0.19 0.21 0.20 0.21	0.09 0.09 0.17 0.27 0.37
Monthly household income [ZAR]	Continuous	min = 2, max = 1,015,900, mean = 7659, weighted mean = 10,425, median = 4724	min = 250, max = 555,000, mean = 10,300, weighted mean = 13,297, median = 6799	-	-
Standard drinks per year	Continuous	min = 6, max = 4745, mean = 274.6, weighted mean = 264	min = 6, max = 4745, mean = 298, weighted mean = 246	min = 6, max = 11,336, mean = 309, weighted mean = 335	min = 6, max = 11,336, mean = 309, weighted mean = 321
Age	Continuous	min = 13, max = 108, mean = 36.71, weighted mean = 37	min = 14, max = 99, mean = 39, weighted mean = 40	min = 15, max = 95, mean = 37, weighted mean = 37	min = 15, max = 95, mean = 37, weighted mean = 40

The model runs from a base year of 2018. The population in the Western Cape for 2018 was 5,015,567 (Machemedze et al., 2020).

The SADHS reported drinking (both mean and peak) was calibrated, using the Gamma shift method established in the alcohol modelling literature (Rehm et al., 2010), to increase everyone's alcohol consumption such that total consumption aligned with a 15% Western Cape share of the Euro monitor figure (only 80% of the Euromonitor figure is used, as is convention to account for spillage, stockpiling, and tourist consumption). Following the calibration, we can see the share of drinker types in the survey. We did explore alternate drinker definitions, in line with the work of Corne Van Walbeek and Grieve Chelwa, such as splitting heavy drinkers into regular heavy drinkers and intermediate drinkers who drink 3 or four drinks on a standard drinking day. We found that there were not enough intermediate drinkers in the SADHS survey to provide sufficient sample size. It should be noted that 93% of heavy drinkers in our model binge-drink.

C. Adjusting the elasticities

The elasticities used in the original model were -0.4, -0.22 and -0.18 for moderate, occasional binge, and heavy drinkers respectively (van Walbeek and Chelwa, 2019). We adjusted these elasticities to incorporate an income gradient, using elasticities of -0.86 and -0.5 for low and high socioeconomic status (Van Walbeek and Blecher, 2014). To be conservative, we count the bottom two quintiles as low SES and the top three as high.

Table C1: Adjusting elasticities

Drinker type	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**
Moderate	-0.53	-0.53	-0.31	-0.31	-0.31
Occasional binge	-0.29	-0.29	-0.17	-0.17	-0.17
Heavy drinkers	-0.24	-0.24	-0.14	-0.14	-0.14

D. Calculation of baseline health conditions

We used data from Statistics South Africa (Statisitcs South Africa, 2020) on the notification of deaths and estimates from the Second National Burden of Disease (NBD) Study (Pillay-van Wyk et al., 2016) and the Second Injury Mortality Survey (Prinsloo, (in press) to recover plausible estimates for the number of deaths attributable to HIV/AIDS, Tuberculosis, Intentional injuries, Road injuries, Liver Cirrhosis and Breast Cancer among adults (15 years and older) in the Western Cape in 2017, by sex. We used the year 2017 as a reference, as no reliable death estimates are available after that year.

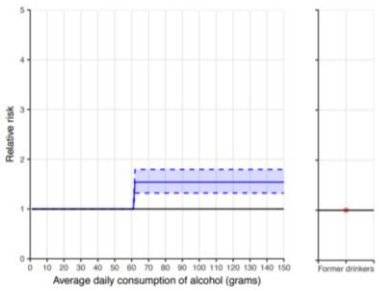
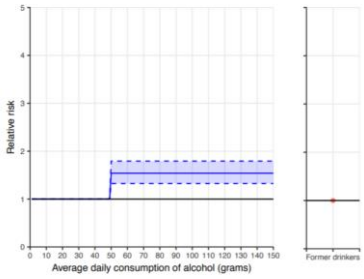
For HIV and AIDS, we extrapolated data pre-2013 linearly from the NDB study to recover estimates for the year 2017. For breast cancer and liver cirrhosis, we adjusted Statistics South Africa estimates for 2017 by adding the average difference pre-2013 to the NBD estimates, approximately constant. For injuries, we used 2017 population totals from the Injury Mortality Survey and applied sex and age ratios from the NBD study to extract sex-specific estimates for adults only.

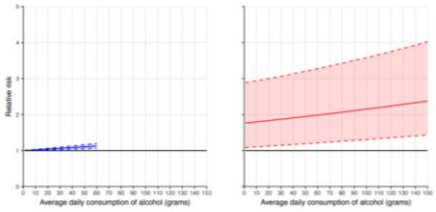
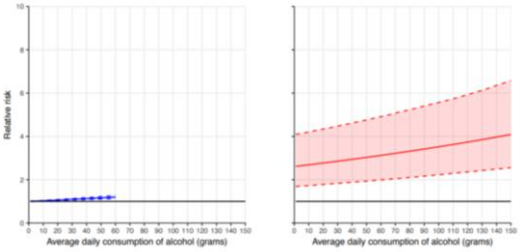
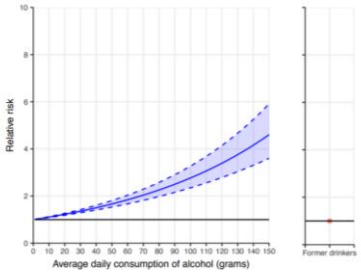
We extracted data on prevalence of HIV/AIDS and tuberculosis from the Western Cape burden of disease review (Davies et al., 2020). No data at the provincial level were available for the prevalence of breast cancer, liver cirrhosis, and injuries. Therefore, we approximated their value by multiplying the number of deaths estimated, as described above, by the ratio between prevalence and deaths extracted from the Global Burden of Disease study (IHME), 2019).

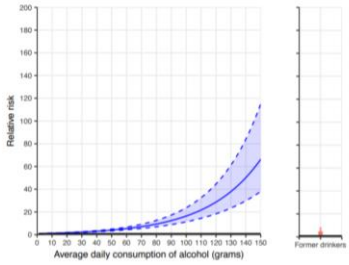
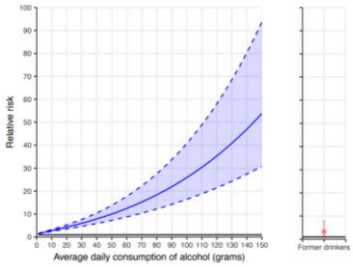
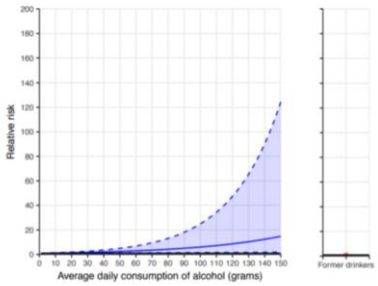
E. Relative risks used in the model

Relative risks (Table E1) were calculated for each of the health outcomes of interest at the baseline, and for each policy scenario using published relative-risk equations (Shield et al., 2020).

Table E1: Relative Risks per health outcome

Health Condition	Relative risk Current drinkers	Relative risk former drinkers	ICD-10 codes
HIV	Low SES $RR = 2.99$ if x > 61/49 grams per day (males/females) $RR = 1.94$ if x > 0 $RR = 1$ otherwise Higher SES $RR = 1.54$ if x > 61/49 grams per day (males/females) $RR = 1$ otherwise  **Figure A2.** Relative Risks and 95% confidence intervals for HIV/AIDS among male current and former drinkers (as compared to lifetime abstainers)  **Figure A3.** Relative Risks and 95% confidence intervals for HIV/AIDS among female current and former drinkers (as compared to lifetime abstainers)	RR = 1	B20-24
Intentional Injuries **(self-harm and interpersonal violence)**	Drinkers $RR = \exp(0.0199800266267306 \, . \, x)$ Heavy episodic drinkers (HED) $RR = \exp(0.0199800266267306 \, . \, x + 0.647103242058538)$	RR = 1	ICD-10 codes: X60 – Y09 Y35 –36 Y870 Y871

	 re A39. Relative risks and 95% confidence intervals for self-harm and interpersonal violence among male and female heavy episodic drinkers (blue) and heavy episodic drinkers (red)		
Road Injury **(pedestrian, cyclist, motorcyclist, motor vehicle, other road)**	Drinkers $RR = \exp(0.00299550897979837 \,.\, x)$ Heavy episodic drinking $RR = \exp(0.00299550897979837 \,.\, x + 0.959350221334602)$  **Figure A37.** Relative risks and 95% confidence intervals for road injury among male and female non-heavy episodic drinkers (blue) and heavy episodic drinkers (red)	RR = 1	V01–04, V06, V09–80, V87, V89, V99
Breast Cancer	Females only $RR = \exp(0.01018 \,.\, x)$  **Figure A12.** Relative Risks and 95% confidence intervals for breast cancer among female current and former drinkers (as compared to lifetime abstainers)	RR = 1	C50
Liver	if x <= 1 $1 + x.\exp((\beta_1 + \beta_2).\sqrt{\frac{1 + 0.1699981689453125}{100}})$ If x > 1 $\exp((\beta_1 + \beta_2).\sqrt{\frac{x + 0.1699981689453125}{100}})$ Female b1 = 2.351821	RR = 3.26 for both females and males	K70, K74

	b2 = 0.9002139 Male b1 = 1.687111 b2 = 1.106413  **Figure A33.** Relative risks and 95% confidence intervals for liver cirrhosis among male current and former drinkers (as compared to lifetime abstainers)  **Figure A34.** Relative risks and 95% confidence intervals for liver cirrhosis among female current and former drinkers (as compared to lifetime abstainers)		
TB	$RR = \exp(0.0179695 \, . \, x)$  **Figure A1.** Relative Risks and 95% confidence intervals for tuberculosis among male and female, current and former drinkers (as compared to lifetime abstainers)	RR = 1	A15-19, B90
x = grams of alcohol consumed per day among current drinkers HED = drinking 60 grams or more on one drinking occasion			

F. Healthcare cost savings

The prevalence of disease or injury, for each policy scenario for each year of the model run, was multiplied by the proportion of people who would then go on to receive hospital treatment and the relevant hospital cost was applied. The costs taken from the literature were increased by inflation where necessary to reach the baseline year of 2018. Future costs were discounted at 5%, as recommended by the Department of Health in the guidelines for pharmacoeconomic submissions (Republic of South Africa, 2012).

The data sources were discussed with Mayara Fontes, a health economist based at the University of Cape Town, to ensure face validity.

Condition	Multiplier (cases in population who go on to receive healthcare treatment)	Source
HIV	0.62	UNAIDS estimates that 62% of people living with HIV in 2018 in South Africa were on treatment (UNAIDS, 2020).
Intentional Injury	0.41	Survey estimating trauma admissions (Matzopoulos et al., 2006) combined with IHME data from the same year to predict multipliers (Appendix A).
Road injury	0.19	Survey estimating trauma admissions (Matzopoulos et al., 2006) combined with IHME data from the same year to predict multipliers (Appendix A).
Liver Cirrhosis	0.50	Paper on liver cirrhosis in sub-Saharan Africa suggesting that 50% of patients are admitted to hospital with end-stage liver disease (Vento et al., 2018).
Breast Cancer	0.75	All studies found estimate what proportion present with late stage breast cancer (51%) but not what proportion never receive hospital treatment (Joffe et al., 2018). Therefore an estimate of 0.75 is used.

Condition	Annual cost per patient	Source
HIV	R 3,319 (2017/18)	This is the annual cost. Taken from a systematic literature review of per patient costs of HIV services in South Africa (Meyer-Rath et al., 2019). There are many different levels of treatment; this cost is only for first-line treatment, making it conservative.
Intentional Injury	R58,928 (2013) R31,000 (2006)	This retrospective case note review included 143 violence related emergency hospital admissions from January to March 2013. Average inpatient stay was 9.8 days, with treatments including emergency surgery, intensive care, and resuscitation beds on admission (Bola et al., 2016). A study based at the Tygerberg tertiary teaching public hospital situated in Cape Town, using data from 2006, estimated that firearm injuries cost R31,000 (2230 USD) and

		have average inpatient days of 5.8 days. (Norberg et al., 2009). Our preference would be to use the figure of R58,928 as it is not limited to only firearms admissions. However, the South African health economist consulted suggested R58,928 is rather high so we use R31,000 to remain on the conservative side.
Road injury	R56,592 (2012)	A prospective cohort study followed 100 patients admitted following a road traffic injury between late 2011 and early 2012 at Edendale Hospital Pietermartizburg (Parkinson et al., 2014). These data are also from the KwaZulu-Natal Province. A systematic review of the cost of injury and cost of prevention for road traffic injuries in LMICs only found one paper for South Africa, the one already available to us (Wesson et al., 2016). Therefore the study cited above seems to be the best available option.
Liver Cirrhosis	R2,502 (2018)	The 50% multiplier used above comes from paper suggesting that 50% of liver cirrhosis patients are admitted to hospital with end-stage liver disease. A specific study on liver cirrhosis was not found, therefore general costs have been used from the district health barometer. Expenditure per patient day equivalent (district hospitals) for the Western Cape in 2018 was R2,502. Our costs assume just one patient day to be conservative. (Health Systems Trust, 2020)
Breast Cancer	Early stage R14,915 Late stage R16,869 (2015)	This retrospective case review included 200 women at a government hospital in Cape Town, South Africa. The average cost varies depending on whether they were diagnosed at an early (56%) or late (44%) stage (Guzha et al., 2020).
TB	R3193 (this needs to be inflated from 2011 to 2018)	Costs of treating DS/MDR/XDR TB with a total cost of cases was $86 mill/$50 mill/$20 mill for 336,332/7,386/741 cases in a 2011 study. The annual cost per patient was $156 million divided by 344,459, or about $453. These are annual costs. All costs were expressed in 2011 $US at an exchange rate of $1USD=ZAR7.05; $453 = R3,193. (Pooran et al., 2013) These costs were drawn from a Western Cape hospital.

G. Taxation and retail revenue

The total retail expenditure at the baseline, and for each scenario, was computed by adding up all the individual expenditures multiplied by their population weights. This figure was then increased by 1.25 (100/80) to take account of the fact that consumption had only been calibrated to 80% of official sales volume data. This was repeated at R5, R8 and R12.

- Calculate VAT by assuming 15% of the base retail expenditure is VAT.
- Import base excise tax from the Treasury Budget Report for 2018, take 17% of this as owing to the Western Cape, as the NIDS survey indicated 17% of the total spent on alcohol came from the Western Cape.
- Calculate total volume consumed of alcohol for all four scenarios.
- Calculate the percentage change in volume from the baseline for each of the three policies.
- Apply the percentage change in volume to the base excise tax (this assumes a fixed ratio between volume and excise tax).
- Calculate retail revenue by expenditure, VAT, and excise tax.

It is likely this is conservative for excise tax revenue as generally the cheaper alcohol, which this policy targets, will be paying a lower proportion of excise tax than the more expensive, and therefore we can consider this a lower band for excise tax revenue.

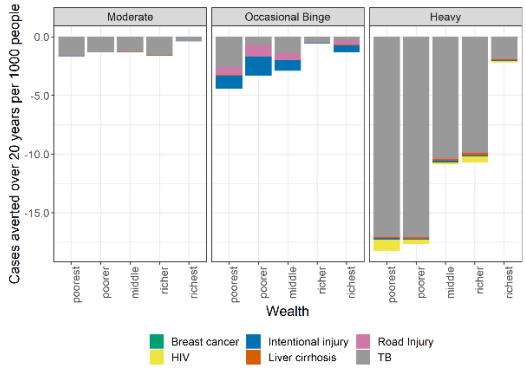
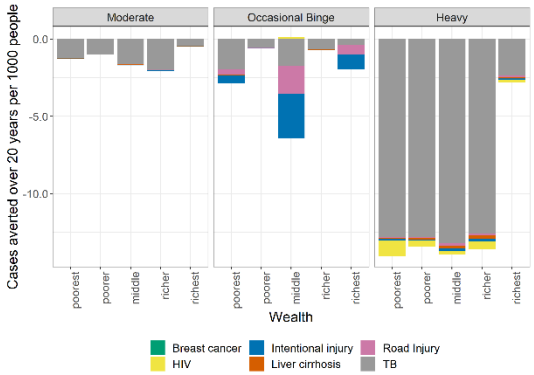
H. Crime

A comprehensive estimation of the cost of crime in South Africa split institutional costs into correctional services, police and public security, and justice (Alda and Cuesta, 2011). These were estimated at 0.54, 1.65 and 0.36 per cent of GDP respectively. Alcohol-attributable fractions of 38.5% for correctional services, 22.5% for police and public security, and 2% for justice were estimated by Budlender (2009) and subsequently published in a cost of alcohol-harm use study (Matzopoulos et al., 2014). The Western Cape GDP in 2018 was estimated using the Western Cape GDP per capita R97,663 (Statistics South Africa, 2018) and multiplying it by our Western Cape population estimate of 6,723,007 at R657 billion. We assume the percentage reduction in consumption relates to an exact percentage reduction in alcohol-attributable crime costs, calculated for each policy scenario.

I. Sensitivity analysis

Here we present Figure 11 from the main results with a reproduced version using elasticities which do not vary by wealth quintile but only by drinker type. It is clear that the wealth gradient in health impact is lost when we compare them side by side (Figure I1).

Appendix Figure I1: Comparing the health outcomes with different elasticity estimates

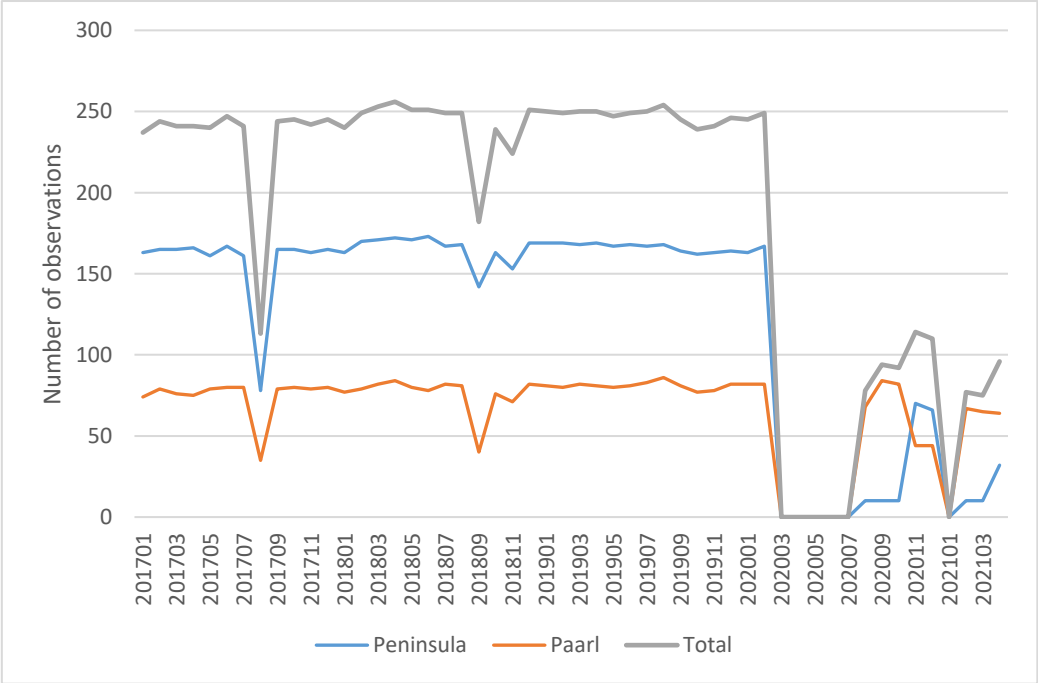
Elasticities which vary by drinker and wealth group	Elasticities which vary only by drinker group
	

J. Data processing for the calculation of alcohol prices

As an input to the calculation of the Consumer Price Index, which is used to calculate the inflation rate, Statistics South Africa collects the retail prices of a range of alcohol products in various locations in South Africa. Since the focus of this study is on the Western Cape, the analysis below excludes the other eight provinces. REEP has an agreement with Statistics South Africa, whereby they send us the price data monthly, subject to the condition that we cannot disclose the various brand names in public documents. For each record, we receive the following: (1) product category (beer, wine, brandy, whiskey, vodka, spirit cooler or cider), (2) brand name, (3) survey month, (4) packaging type, (5) province, (6) city or town, and (7) retail price.

For each province, Statistics South Africa collects data from between two and eight different cities or towns. For the Western Cape, there are only two locations: (1) the Cape Peninsula and (2) Paarl. For this analysis, we had data from January 2017 to April 2021. Because of sporadic sales bans on alcohol during the Covid-19 lockdown, no data were collected between March 2020 and July 2020 and in January 2021. As indicated in Figure J1 below, for the period between 2017 and 2019, about 250 prices, on average, were collected each month. About two-thirds of the data were collected in the Cape Peninsula and one-third in Paarl. According to the head of the CPI division at SSA, the sampling frame includes large chain liquor stores and smaller independent stores. In normal conditions, they have 12 outlets in the Western Cape sample. Since March 2020 the data collection has been much more erratic.

Figure J1: Number of price observations collected each month



Given the relatively low data coverage since March 2020, we used all the data available, i.e., since January 2017. For the years 2017 to 2020 we adjusted the hypothetical MUP figures to account for inflation. Taking 2021 as the base year, we calculated an inflation adjustment factor, based on the annual CPI value for each calendar year, with which we deflated the relevant hypothetical MUP value. These deflation factors were 0.851 for 2017, 0.891 for 2018, 0.927 for 2019, and 0.958 for 2020. As an example, a hypothetical MUP value of R5.00 in 2021 would be equivalent to 0.851 x R5.00 = R4.255 in 2017.

The first step of the analysis was to clean the data. The brand data, in particular, required extensive cleaning, as there were many spelling and typographical errors. In the second step of the analysis, we searched for the alcohol content for each of the brands on the internet and added that to the dataset. We were able to find the alcohol content (ABV) for more than 95% of records. Where we were unable to find this, we used average ABV values for that product category. In the third step, we calculated the number of standard units of alcohol for each data observation. For example, for a 750 ml bottle of vodka, with alcohol content (ABV) of 43%, the number of standard units of alcohol is calculated as 750 x 0.43/15 = 21.5 standard units. For a six-pack of beer, with an alcohol content of 5%, with each can being 330 ml, the number of standard units of alcohol would be calculated as 6 x 330 x 0.05/15 = 6.6 standard units.

In the fourth step, we multiplied the number of standard units by the chosen value of the MUP, to see what the retail price should be. For the years 2017 to 2020, we adjusted the MUP by the deflation factor as indicated earlier. We used seven different MUP values, namely R4, R5, R6, R7, R8, R9 and R10, per standard drink.

In the fifth step, we calculated the number and the proportion of observations, subdivided into categories, that would be affected by the MUP. "Affected by the MUP" is defined as a situation where the minimum retail price, based on the MUP value, is greater than the reported retail price. It goes without saying that as the MUP value increases, a larger number (and thus a greater proportion) of products will be affected by the MUP.

This analysis has multiple shortcomings. As such it is indicative at best. Some of the main shortcomings are the following:

1. The analysis applies only to the products that are included in SSA's sampling frame. Many product categories are not included. For example, there are no price data on sorghum beer, sherry, port, rum,

or cane spirit. Furthermore, only a limited number of "ready-to-drink" beverages are followed by SSA.

2. The geographic coverage is limited to the Cape Peninsula and Paarl. Medium-sized and small towns are not covered. It seems likely that liquor prices in these towns are similar to those in the Peninsula and Paarl, but there is no way of knowing this with the data collected by SSA.
3. Although SSA does not indicate which liquor outlet is selected, or whether this changes over time, the range of products recorded suggests that the prices are recorded at a number of formal outlets, which sell a wide range of alcohol.
4. Very cheap and low-quality alcoholic beverages are not included in the sampling frame, and the prices of these are therefore not recorded. For example, there is anecdotal evidence that "bakkie-sellers" are selling plastic 5-litre containers of very cheap wine on farms and in informal areas.
5. The alcohol prices are for off-site purchases only; alcohol sold at bars, restaurants and shebeens is not recorded by SSA. However, as on-site alcohol prices tend to be substantially higher than off-site prices, it is unlikely that an MUP will substantially affect them.

As was indicated in Van Walbeek and Chelwa (2021), heavy drinkers tend to consume much cheaper alcohol than moderate drinkers. The unit values (as an approximation of the price), calculated for heavy drinkers, were much lower than the prices recorded by SSA, which suggests that SSA may have missed a substantial proportion of the types of alcohol that are consumed by heavy drinkers.

Taken together, these shortcomings and limitations indicate that the impact of an MUP on alcohol is likely to be greater than indicated in this report. Cheap products, which are currently not monitored by SSA, will be affected by the imposition on an MUP, probably quite substantially. As such, the results reported here can be regarded as a lower limit in terms of impact.

APPENDIX K

Liquor prices in informal settlements in the Cape Town Metropole

Statistics South Africa (SSA) collects price data from a number of retail outlets in the Western Cape. These are takeaway outlets, presumably in the formal sector (SSA does not reveal the identities of the outlets). In order to gain a better understanding of the prices of alcohol sold in the informal settlements, we conducted an informal survey of retail outlets, shebeens and restaurants in these areas in August 2021 (after the alcohol sales ban was lifted in XXX).

We used a similar approach to the one we use to collect tobacco prices with the African Cigarette Prices (ACP) Project. After obtaining ethics clearance, we recruited students at UCT to be fieldworkers. They receive training and appropriate documentation. For the alcohol study, they were given instructions to look for the cheapest possible alcohol, expressed in rands per unit of alcohol (i.e. 15 ml). They were encouraged to visit as many outlets as possible.

At the time of writing (3 September 2021) fieldworkers have submitted 128 entries of alcohol that was sold at R8 per unit or less. These were from five regions in the Cape Town Metropole: Capricorn, Grassy Park, Gugulethu, Khayelitsha and Masiphumelele. An analysis of the results indicate that the prices recorded by the fieldworkers are rather similar to the price trends recorded by SSA. The most important findings are the following:

1. The cheapest alcohol found was a 5-litre box wine, with 14% ABV, sold in a tavern in Gugulethu at R140,00, which translates to R3.00 per unit.
2. Wine more than any other beverage, are the cheapest category of alcohol. Of the 128 entries of alcohol prices selling for less than R8.00 per unit, 91 (71%) were for wine, followed by beer with 22 entries (17%). Alcohol categories that sold for less than R8.00 per unit include vodka, brandy, cider, gin and sherry, but not many observations of these categories of alcohol were collected.
3. Where wine was old for less than R4.00 per unit of alcohol (there were 24 (19%) observations), the containers were nearly exclusively 5-litre or 3-litre boxes.
4. As the price increases to above R4.00 per unit of alcohol, large non-box containers (i.e. 1-litre bottles, 1.5 litre bottles and 2-litre bottles) of wine become more common.
5. The cheapest non-wine product collected by our fieldworkers was a 200 ml bottle of brandy (43% ABV), sold for R30 in Capricorn. The price per unit of alcohol is R5.43.
6. The cheapest beer was a 750 ml bottle of Lion Lager (4% ABV) sold for R11 in Khayelitsha (= R5.58 per unit of alcohol).
7. The second cheapest beer was a 750 ml bottle of Carling Black Label (5.5% ABV), sold at the same place in Khayelitsha, and at another outlet in Gugulethu for R16.00 (= R5.82 per unit of alcohol)
8. A substantial number of entries indicated that beer in 750 ml bottles was sold at R20 (=R8 per unit of alcohol)
9. The fieldworkers did not come across any super-cheap sugar-fermented alcohol. Anecdotal evidence from an informal survey in 2016 in some of the smaller towns in the Western Cape indicate that they were selling at well below R2.00 per unit of alcohol at the time.
10. The “mystery” of the super-cheap alcohol consumed by heavy drinkers, as identified in NIDS wave 4 of 2014, remains unresolved. It seems likely that these heavy drinkers have under-reported their expenditure on alcohol by a greater proportion than their consumption of alcohol.