USING PRICE-BASED INTERVENTIONS TO REDUCE ABUSIVE DRINKING IN THE WESTERN CAPE PROVINCE

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EXECUTIVE SUMMARY

The Alcohol-related Harms Reduction White Paper, which was adopted by the Western Cape Provincial Cabinet in August 2017, outlines the Western Cape Government's policy with respect to curbing alcohol misuse in the province. The White Paper is a comprehensive document and discusses the rationale for intervening in the alcohol sector in detail. Alcohol misuse in the Western Cape, like in the rest of South Africa, has a very detrimental impact on individuals, families, and the community. The White Paper recommends a large number of interventions, many of which are community based. It also acknowledges that price and tax measures can be used very effectively to reduce the use and misuse of alcohol.

In May 2018 the DG Murray Trust, citing the Alcohol-related Harms Reduction White Paper, issued a call for a study to conduct an "economic modelling and feasibility study regarding the implementation of pricing mechanisms on alcohol products in South Africa". In particular, the request was to identify the most robust pricing mechanism for reducing heavy episodic (binge) drinking, particularly amongst young people and poor communities.

The Economics of Tobacco Control Project, based at the University of Cape Town, was successful in its bid to conduct the study. The Project is well-respected in the economics of tobacco control, especially in tobacco taxation and tax modelling, and also has some research experience in the economics of alcohol policy.

The focus of this study is narrow, namely, how can the Western Cape Government use price mechanisms to reduce the harmful use of alcohol, in particular heavy episodic drinking? The single most important concept that the report uses is the *price elasticity of demand*. The price elasticity of demand predicts by what percentage the quantity demanded (or quantity consumed) changes in response to a 1% change in the price of the product. For example, if the price elasticity is -0.5, a 10% increase in the price decreases consumption by 5%, all other things unchanged. From a policy perspective, the magnitude of the price elasticity of demand is crucial. For example, if the government wants to reduce the consumption of a product, and the product has a very low price elasticity of demand (say -0.05), then an increase in the price of that product by means of an excise tax or another price-based intervention, will not be very effective.

Currently excise taxes on alcohol are levied by national government. The amount is set by National Treasury on an annual basis. The excise tax is levied as a specific tax, which means that the tax amount is based on volume. For beer, spirits, and fruit-based alcoholic beverages the excise tax is levied on the quantity of absolute alcohol, rather than the quantity of the actual beverage, whereas for wine (including fortified and sparkling wines) the excise tax is levied on the volume of the beverage, irrespective of the strength of the alcohol. From an economic and public health perspective, a tax on the alcohol content is generally regarded as superior to a tax that is levied on the total volume of the beverage.

Using data from the National Income Dynamics Study (NIDS) we constructed an "index of alcohol use" for South Africa's nine provinces. An index value of more than 100 indicates that the province's alcohol consumption is greater than the country average, while an index value of less than 100 indicates that it is less than the country average. Whereas the Western Cape's alcohol consumption is above the country average (with an index greater than 100), it is by no means the highest. The Northern Cape

consistently has the highest index of alcohol use, followed by North-West Province and the Western Cape, in that order. The Free State's index is also consistently above 100, but less than that of the Western Cape. South Africa's poorer provinces, specifically Limpopo, Mpumalanga, the Eastern Cape and KwaZulu-Natal have indices of alcohol use well below 100.

The overall message of this exercise is that alcohol use in the Western Cape is relatively high but that it is not extraordinarily high in comparison with other provinces. It would not be correct to argue that alcohol use is concentrated in the Western Cape. Although there are some clear provincial differences in alcohol volumes, prevalence of use and intensity of use among drinkers, the Western Cape is most certainly not an outlier. To the extent that alcohol misuse is a problem, it is a national problem, rather than a provincial problem.

The international literature on the demand for alcohol is expansive, encapsulating different methods, datasets, countries and subsets of the drinking population. The literature, however, consistently finds that alcohol consumption responds, on average, to increases in alcohol prices. The consensus estimates place the price elasticity of demand at about -0.5, meaning that a 10% increase in alcohol prices results in a 5% decline in alcohol consumption. Beer tends to be the least responsive followed by wine and spirits, in that order. There are also heterogeneous responses across drinker types with heavy drinkers responding less to price changes than light to moderate drinkers. The price responses for binge drinkers are more uncertain with some studies indicating low elasticities and others finding large elasticities. In terms of socioeconomic and demographic groups, the literature finds that the young, poor and women are more responsive to prices than their comparator groups.

Using data from NIDS we are able to estimate price elasticities of demand for the overall drinking population and sub-samples of that population in South Africa. We find overall elasticity estimates in line with international literature – alcohol consumption responds to price changes in South Africa, as it does internationally. In terms of sub-groups of the drinking population, we find that binge drinking households decrease their consumption by about 2%-2.5% in response to a 10% increase in the price of alcohol. Other heavy drinking households respond the least to price changes. For such households a 10% increase in the price is associated with about 1.5%-2% decrease in consumption. Moderately drinking households reduce their consumption by about 4% when faced with a 10% increase in the price of alcohol.

Using our estimated price elasticities of demand, we conduct two simulation exercises. The first one considers the possible impact of the Western Cape imposing a provincial excise tax on alcohol. We find that the imposition of such a tax would be expected to decrease alcohol consumption among all categories of drinkers, with the greatest impact on moderate drinkers, followed by binge drinkers and heavy drinkers (in that order). Depending on the magnitude of the tax, the Western Cape Government would be able to generate substantial revenues from the excise tax. However, since no province in South Africa currently imposes a provincial excise tax on alcohol (or any other excisable good), implementing this tax in the Western Cape would be unprecedented and is likely to be difficult. As there is freedom of movement across provincial borders, it would be very difficult to levy the tax at source (i.e. on producers), as is typically the case for excise taxes. To levy the excise tax on retailers would require the establishment of a completely new tax collecting infrastructure. Since the Western Cape and the other provinces currently do not have this tax collecting capacity, the onus to collect these provincial taxes might have to be contracted out to the South African Revenue Services.

The second simulation exercise considers the impact of the introduction of a minimum unit price for alcohol in the Western Cape Province, and for the country as a whole. We find that, for both the country and the province, a minimum unit price is likely to reduce alcohol consumption among heavy drinkers by a substantially higher percentage than consumption of binge drinkers and moderate drinkers. For the country the impact of a minimum unit price on binge and moderate drinkers is broadly similar. However, for the Western Cape the imposition of a minimum unit price is likely to have a substantially larger impact on the drinking patterns of binge drinkers than on moderate drinkers.

Recommendations

We advise against a provincial excise tax given how untargeted it might be and considering the administrative and political hurdles the province would have to confront to implement it. Since alcohol abuse is not limited to the Western Cape, the provincial government would be best advised to lobby National Treasury to substantially increase the national excise tax on alcohol.

Even though it would not raise revenue for the Western Cape Government, a minimum unit price on alcohol has the potential to substantially reduce alcohol consumption among binge drinkers and, especially, other heavy drinkers. Such a policy would target very cheap, low-quality products. A minimum unit price is a much sharper and more targeted policy instrument than a provincial excise tax on alcohol. Therefore, we recommend that the Western Cape Government should strongly consider a minimum unit price for the province, but that it should do much more research about the practicalities of implementing such a policy.

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1. Introduction

The Alcohol-related Harms Reduction White Paper, which was adopted by the Western Cape Provincial Cabinet in August 2017, outlines the Western Cape Government's policy with respect to curbing alcohol misuse in the province (Western Cape Government, 2017). The White Paper is a comprehensive document and discusses the rationale for intervening in the alcohol sector in detail. Alcohol misuse in the Western Cape, as in the rest of South Africa, has a very detrimental impact on individuals, families, and the community. The cost of alcohol on South Africa has been estimated to be as high as 12% of the country's GDP (Matzopoulos, et al., 2014).

The White Paper recommends a large number of interventions, many of which are community-based. It also acknowledges that price and tax measures can be used very effectively to reduce the use and misuse of alcohol. In fact, the World Health Organisation (WHO) has identified increased prices and taxes on alcohol products as one of the "best buys" to improve public health (WHO, 2011). The White Paper recommends that the Western Cape Government should lobby the national government to increase the excise tax on alcohol and that "a provincial tax will also be considered due to the effectiveness of the tax mechanism" (Western Cape Government, 2017, p5).

In May 2018 the DG Murray Trust, citing the Alcohol-related Harms Reduction White Paper, issued a call for an "economic modelling and feasibility study regarding the implementation of pricing mechanisms on alcohol products in South Africa". In particular, the request was to identify the most robust pricing mechanism for reducing heavy episodic (binge) drinking, particularly amongst young people and poor communities.

The Economics of Tobacco Control Project, based at the University of Cape Town, was successful in its bid to conduct the study. The Project is well-respected in the economics of tobacco control, especially in tobacco taxation and tax modelling, and also has some research experience in the economics of alcohol policy.

The focus of this study is narrow, namely, how can the Western Cape Government use price mechanisms to reduce the harmful use of alcohol, in particular heavy episodic drinking? The single most important concept that we will use in this report is the *price elasticity of demand*. The price elasticity of demand predicts by what percentage the quantity demanded (or quantity consumed) changes in response to a 1% change in the price of the product. For example, if the price elasticity is -0.5, a 1% increase in the price decreases consumption by 0.5%, all other things unchanged. If the price elasticity were to be -1.4, a 1% increase in the price would decrease consumption by 1.4%. The greater the price elasticity (expressed in absolute terms), the more sensitive (or responsive) consumers are to changes in the price.

From a policy perspective, the magnitude of the price elasticity of demand is crucial. For example, if the government wants to reduce the consumption of a product, and the product has a very low price elasticity of demand (say -0.05), then an increase in the price of that product, whether through an excise tax or another intervention, would not be very effective.

Given its importance from a policy perspective, price elasticity of demand forms a pivotal element of this report. In section 2 we provide some definitions and some background statistics that are used in the rest of the report. In section 3 we present a summary of the international literature on the estimated magnitude of the price elasticity of demand for alcohol. In section 4 we present the results of an econometric analysis on the demand for alcohol in South Africa, where we estimate the price elasticity of demand for different categories of alcohol users. In section 5 and 6 we show the results of two simulation exercises, where we investigate the likely consequences of (1) a provincial excise tax, and (2) a minimum unit price for alcohol. In section 7 we discuss these results and provide some more context with respect to the possible implementation of these interventions.

2. Some background statistics

a. Alcohol excise taxes levied by National Treasury

Currently excise taxes on alcohol are levied by national government. The amount is set by National Treasury on an annual basis. In South Africa, alcohol has been subject to excise taxes since at least 1910. The excise tax is levied as a specific tax, which means that amount of the tax is based on volume. Had the tax been levied as an ad valorem tax, it would have been levied as a percentage of value. For beer, spirits, and fruit-based alcoholic beverages the excise tax is levied on the quantity of absolute alcohol,[1] rather than the quantity of the actual beverage, whereas for wine (including fortified and sparkling wines) the excise tax is levied on the volume of the beverage, irrespective of the strength of the alcohol. From an economic and public health perspective, a tax on the alcohol content is generally regarded as superior to a tax that is levied on the total volume of the beverage. As well as discouraging use by drinkers (i.e. reducing the demand for alcohol), the tax also acts as an incentive to producers to reduce the alcohol content of the beverage (i.e. reducing the supply of pure alcohol). These incentive effects have resulted in changes in behaviour by the producers of alcohol. For example, over the past two decades the beer industry has actively marketed lower-alcohol beer (e.g. Castle Lite and Windhoek Lite) as a premium product (Blecher, 2015). From a public health perspective this is a positive development.

For wine, the excise tax is levied on the volume of the beverage as it is administratively too cumbersome to levy the excise tax on the alcohol content, because wine is a highly diversified product sold in a very fragmented market. There are literally thousands of different brands, each with a somewhat different alcohol content. From an administrative perspective, taxing the volume of beverage is a pragmatic compromise. The excise tax on traditional African beer (sorghum beer) is trivially low and has remained unchanged in nominal terms for more than a decade. This, together with the fact that sorghum beer sales have been in long-term decline, drove our decision to exclude sorghum beer from further analysis in this report.

Table 1 shows the current (2018/19) rates of excise taxes on alcohol products, as levied by National Treasury. The focus in this report will be primarily on three main categories, namely beer, wine and spirits.

[1] The terms “absolute alcohol” and “pure alcohol” are used as synonyms in this report.

Table 1: Excise taxes on alcohol, levied by National Treasury, 2018/19 financial year

	Base of the tax	***Amount per litre***
Malt beer	Absolute alcohol	R95.03
Traditional African beer (sorghum beer)	Beverage	R0.0782
Traditional African beer powder	Kg	R0.3470/kg
Unfortified wine	Beverage	R3.91
Fortified wine	Beverage	R6.54
Sparkling wine	Beverage	R12.43
Ciders and alcoholic fruit beverages	Absolute alcohol	R95.03
Spirits	Absolute alcohol	R190.08

Source: National Treasury (2018), Table 4.7

b. Alcohol use in the Western Cape and other provinces

The White Paper provided a comprehensive exposition of alcohol use in South Africa and the health and socioeconomic impact of alcohol use and misuse. This report does not aim to add to the White Paper, but does want to highlight some important trends that are important in later arguments.

Table 2 shows the distribution of the adult population (15+) and alcohol consumption in South Africa's nine provinces, for three years, 2008, 2012, and 2014. This data is based on three waves of data from the National Income Dynamics Study. (See Appendix A for a discussion of the two main data sources used in this report).

Table 2: Distribution of the adult population and total alcohol consumption, by province

	Wave 1 (2008)			Wave 3 (2012)			Wave 4 (2014)		
	Adult pop. share	Alcohol share	Index of alcohol use	Adult pop. Share	Alcohol share	Index of alcohol use	Adult pop. share	Alcohol share	Index of alcohol use
Western Cape	11.1	16.4	*147.5*	11.5	14.2	*123.0*	12.2	15.1	*123.7*
Eastern Cape	11.9	11.7	*97.9*	12.1	7.4	*61.0*	11.9	9.3	*78.5*
Northern Cape	2.5	3.9	*155.6*	2.4	4.4	*179.9*	2.6	4.2	*166.2*
Free State	5.7	6.0	*104.2*	5.7	10.4	*183.3*	5.1	5.9	*115.2*
KZN	18.2	19.5	*107.2*	18.6	11.4	*61.4*	19.6	12.5	*63.8*
North West	5.6	8.5	*150.4*	5.2	7.2	*140.6*	5.2	7.7	*148.9*
Gauteng	26.9	23.1	*85.9*	27.8	32.3	*116.3*	26.3	32.9	*125.0*
Mpumalanga	8.2	6.0	*72.8*	7.9	5.7	*72.0*	8.2	5.6	*68.1*
Limpopo	9.7	4.9	*50.5*	8.9	7.0	*79.3*	9.0	6.8	*75.7*
Total	100.0	100.0	*100.0*	100.0	100.0	*100.0*	100.0	100.0	*100.0*

Source: National Income Dynamics Study, various waves.

While the Western Cape is home to about 12% of South Africa's adult population, its inhabitants consume between 14.2% and 16.4% of total alcohol consumed in the country. The "index of alcohol use" is defined as the alcohol share of a province, divided by the adult population share, and is shown in italics in Table 1. An index value of more than 100 indicates that the province's alcohol consumption

is greater than the country average, while an index value of less than 100 indicates that it is less than the country average. This index is based on the total volume of alcohol consumed, not on the number of consumers. The Northern Cape consistently has the highest index of alcohol use, followed by North-West Province and the Western Cape, in that order. The Free State index of alcohol use is also consistently above 100, but less than that of the Western Cape. Gauteng, in what seems to be an anomaly, had an index of alcohol use less than 100 in 2008, but it increased to well above 100 in 2012 and 2014.

South Africa's poorer provinces, specifically Limpopo, Mpumalanga, the Eastern Cape and KwaZulu-Natal (KZN only in 2012 and 2014), had an index of alcohol use well below 100 in the three years. Unsurprisingly, this table shows that there is a substantial spread in the consumption of alcohol across the nine provinces, and that there seems to be a positive correlation between the level of economic development of a province and its consumption of alcohol.

Unfortunately the NIDS data does not allow one to determine the categories of alcohol that are consumed, since the alcohol-related questions are framed in terms of "standard drinks". A standard drink is defined as a "small glass of wine; a 330ml can of regular beer, a tot of spirits or a mixed drink" (National Income Dynamics Study, 2015, p56). The All Media and Products Survey (AMPS) allows us to consider the various categories of alcohol more closely. The provincial distribution of the consumption of the three main alcohol categories for 2014 is shown in Table 3. This is the latest round of AMPS data that we have available.

Table 3: 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

Given that NIDS and AMPS are completely different in their aims and methodology, some variations in the results are to be expected. Considering the index of total alcohol use, the AMPS data indicates that Gauteng, North-West, the Free State, Mpumalanga and the Northern Cape, in that order, have above average consumption of alcohol use. Other than Mpumalanga, these provinces are also above average consumers of alcohol in the NIDS 2014 dataset, although the order is rather different. For all these provinces, other than the Northern Cape, the "index of use" of the three categories of alcohol

are all above 100. Thus, in these provinces, one cannot say that it is a "beer province" or a "wine province" or a "spirits province". All types of alcohol are consumed at above-average levels.

At the other extreme, the index of alcohol use in the Eastern Cape, KwaZulu-Natal and Limpopo are substantially below 100, for total alcohol consumption and (other than beer in Limpopo) also for the three categories of alcohol. Again, this result is broadly consistent with the findings of NIDS 2014.

The Western Cape is somewhat of an enigma. In contrast to NIDS, the AMPS data suggests that the Western Cape has slightly below-average alcohol consumption. However, with an index of use value of 119.4, the Western Cape can, unsurprisingly, be described as a "wine province". For beer and spirits consumption, the Western Cape is somewhat below the country average.

Table 4 considers the prevalence of use of the three major alcohol categories, by province, in 2014, based on declared use in the past seven days. Thus, in the Western Cape, 23% of adults indicated that they had consumed beer in the past seven days. This percentage closely corresponds to the national prevalence of use for beer. For wine the prevalence of use in the Western Cape is similar to the national prevalence, while for spirits the prevalence of use in the Western Cape (22.7%) is substantially lower than the national prevalence (28.5%).

Provinces with higher than average declared prevalence of use for all three alcohol categories are the Northern Cape, North-West, Gauteng, the Free State and to a lesser extent, Mpumalanga. Prevalence of use above the national prevalence of use is shown in italics in Table 4. Provinces with consistently lower than average prevalence of use are the Eastern Cape, KwaZulu-Natal and Limpopo.

Table 4: Prevalence of use and intensity of use, by province, 2014

	Beer		Wine		Spirits	
	Prevalence of use (%)	Intensity of use (index)	Prevalence of use (%)	Intensity of use (index)	Prevalence of use (%)	Intensity of use (index)
Western Cape	23.0	83.3	*17.7*	117.5	22.7	106.6
Eastern Cape	18.0	74.6	14.3	81.5	23.6	87.7
Northern Cape	*29.9*	94.3	*19.4*	74.5	*31.4*	72.4
Free State	*28.8*	93.8	*20.7*	107.5	*38.3*	105.3
KZN	17.6	88.8	10.3	80.5	21.4	92.7
North West	*29.2*	105.6	*19.9*	99.6	*32.7*	110.7
Gauteng	*27.2*	113.8	*24.2*	101.3	*37.0*	101.3
Mpumalanga	*24.9*	104.1	17.1	104.6	*32.0*	93.5
Limpopo	19.5	119.1	13.6	117.0	21.4	116.5
Total	23.1	100.0	17.5	100.0	28.5	100.0

Source: All Media and Products Survey, 2014

The intensity of use variable is an index that aims to measure the average volume of alcohol consumed by drinkers. It does not take into consideration people who do not consume alcohol. A number above 100 indicates that drinkers in that province consume, on average, more than the country average.

For the Western Cape the intensity of use for beer is substantially lower, for spirits it is slightly higher, and for wine it is substantially higher than the national average. The intensity of use in the Northern

Cape, the Eastern Cape and KwaZulu-Natal are substantially lower than that of the other provinces, but the Western Cape's intensity of use is very similar to that of the other six provinces,

The overall message of this section is that alcohol use in the Western Cape is relatively high, especially when one uses the NIDS data, but that it is not extraordinarily high in comparison with other provinces. It would not be correct to argue that alcohol use is concentrated in the Western Cape. Although there are some clear provincial differences in alcohol volumes, prevalence of use, and intensity of use among drinkers, the Western Cape is most certainly not an outlier. To the extent that alcohol misuse is a problem, it is a national problem, rather than a provincial problem.

3. Review of the international literature

The international literature on the demand for alcohol is expansive, encapsulating different methods, datasets, countries and subsets of the drinking population. This section gives a brief summary of this literature, paying particular attention to estimates of price elasticities for the overall drinking population and subsets of that population. A more exhaustive discussion of the literature is contained in Appendix B of this report.

There is a wide range of estimates of the price elasticity of demand for alcohol, given the many different techniques and datasets used. Some studies use time-series data, i.e. data aggregated at the regional or national level collected over several years. Other studies use cross-sectional data, which is data collected from thousands of observations at the same time. Still others use a combination of the two, referred to as panel studies, to conduct their analyses. The diversity in datasets also naturally implies significant diversity in methods to analyse them

Given this diversity, the best way to get a sense of the overall picture is by reviewing the findings of meta-analyses or meta-studies. Meta-studies extract elasticity estimates from many studies (often hundreds) and use meta-techniques to draw useful conclusions from available estimates. A number of meta-studies have analyzed elasticity estimates in the existing literature on the demand for alcohol. These meta-analyses tend to find that the demand for alcohol is generally price inelastic (i.e. estimates ranging between 0 and -1) and centre around -0.50 (Gallet, 2007; Wagenaar et al., 2009; Fogarty, 2009; WHO, 2017). In terms of types of alcohol, beer tends to be the least responsive to price (an elasticity of about -0.5) followed by wine (-0.7) and spirits (-0.8) (Wagenaar et al., 2009).

Many of the studies referenced in the meta-analyses above and in the general literature on alcohol demand are based on the experiences of high-income countries. This is largely a result of the wide availability of data and resources to conduct such analyses. A few studies have, however, estimated price elasticities of demand in Low- and Middle-Income Countries (LMICs). These studies have been reviewed by Sornpaisarn et al. (2013). They found that the demand for alcohol tends to be slightly more responsive to price in LMICs than in developed countries. The average estimate for LMICs in their review is -0.60, compared to about -0.50 for high income countries. In terms of types of alcohol, the average price elasticity for beer is -0.50, with the average for other types of alcohol (a broad category including wine and spirits) estimated at -0.78.

The main focus point of this report is whether different types of drinkers respond differently to alcohol prices. The literature categorises drinkers into at least one of three types: binge, heavy or moderate

drinkers. The Centers for Disease Control and Prevention (CDC) defines binge drinking as "consuming five or more drinks for men or four or more for women in about two hours" (Centers for Disease Control and Prevention, 2018). The World Health Organization refers to binge drinking as heavy episodic drinking, defined as drinking "60 grams or more of pure alcohol on at least one occasion in the past 30 days" (World Health Organization, 2018). 60 grams of pure alcohol translates into about 5 cans of beer. The distinction between heavy and moderate drinking refers to quantities of alcohol consumed per day, per month or per year, irrespective of whether they are consumed in a rapid manner or not. Many papers define moderate drinking as the consumption of four or fewer drinks in a day, whereas heavy drinking is the consumption of five or more drinks in a day (Saffer et al., 2012; Kenkel, 1996). Others distinguish between moderate and heavy drinking based on monthly consumption. For example, An and Sturm (2011) make the following categorisation: light to moderate drinkers drink 40 drinks or less per month, whereas heavy drinkers consume more than 40 drinks per month.

In terms of responses to price, most studies find that, of the three drinker types, heavy drinkers tend to respond the least to price changes (Harris et al., 2006; Wagenaar et al., 2009; Meier et al., 2010; Ayyagari et al., 2013; Aepli, 2014). The systematic review by Wagenaar et al. (2009) finds a price elasticity of demand for heavy drinkers centred around -0.28. Meier et al. (2010) find a similar estimate for heavy drinkers (-0.21), but a more price elastic response (-0.47) for moderate drinkers. There is, however, much more dispersion in the price response of binge drinkers. The systematic review by Elder et al. (2010) found price elasticity estimates ranging between -0.29 and -1.29.

The impact of alcohol prices on other sub-populations beyond drinker type has also been of interest to researchers. Sub-populations considered here include the young, the old, men, women, the poor and the well-off. A review by Xu and Chaloupka (2011) finds that young people and adolescents tend to be more responsive to price changes than the general population. This is a particularly important finding given that young people and adolescents are more susceptible than any other group to the regular abuse of alcohol. In terms of gender, most studies find that women respond significantly more to price changes than men (Kenkel, 1996; Decker and Schwartz, 2000; Andrienko and Nemtsov, 2006; Shi, 2011). With regard to socioeconomic status, studies using a wide array of proxy measures (income, rural/urban, unemployment status, educational level) find that those of a lower socioeconomic status tend to respond more to price changes than the well-off (Arnoult and Tiffin, 2010; Holmes et al., 2014; Jiang et al., 2016; Kumar, 2016). This is an encouraging finding for policy, given that the poor are more likely to abuse alcohol and therefore carry the burden of severe health outcomes (Jefferis et al., 2007; Schmidt et al., 2010; Cheah, 2014).

Much of the previous discussion has treated alcohol as if it were an amorphous commodity. In reality there are different types of alcohol and it is useful for policymakers to know the degree of relatedness among them, if only to forestall any unintended consequences. The literature concerned with this considers the so-called substitution effects among the three main types of alcohol: beer, wine and spirits. Unfortunately, there is little agreement in the literature. A review study by Bielinska-Kwapisz and Mielecka-Kubien (2011) found that some studies find that beer and wine are strong complements (an increase in the price of either beer or wine tends to lead to a reduction in the demand of the other good), whereas others find that wine and spirits are strong substitutes (i.e. a price increase in one of them results in an increase in demand of the other good). On the other hand, Duffy (2001), using data from the United Kingdom, found that there was no relationship between these three broad alcohol

types. The matter is complicated further by the fact that consumers, in addition to switching between broad alcohol types, tend to switch within alcohol types. Gruenewald (2006), using Swedish data, showed that, in response to increased alcohol prices, consumers substitute between beverages and across beverages. Hobday et al. (2016), using Australian data, concluded that heavy drinkers were more likely to substitute alcohol with cheaper brands in the face of high alcohol prices.

Due to data constraints, we were not able to estimate price elasticities for South Africa for individual categories of alcohol.

The conclusion we reach from the literature review is that alcohol consumption responds, on average, to changes in alcohol prices. The consensus estimates in the literature place the price elasticity of demand at about -0.5, meaning that a 10% increase in alcohol prices results in a 5% decline in alcohol consumption. Beer tends to be the least responsive followed by wine and spirits, in that order. There are also heterogeneous responses across drinker types, with heavy drinkers responding less to price changes than light to moderate drinkers. The price responses for binge drinkers are more uncertain, with some studies indicating low elasticities and others finding high ones. In terms of socioeconomic and demographic groups, the literature finds that the young, the poor, and women are more responsive to prices than their comparator groups.

4. Estimating the price elasticity of demand for alcohol in South Africa

The price elasticity of demand for alcohol is a crucial parameter in any demand-side interventions. In this section we provide estimates of the price elasticity of demand for alcohol in South Africa.

As stated in Section 3, there are various approaches to estimating alcohol demand elasticities using different types of data. For this study, we use data from 3 waves of the National Income Dynamics Study (NIDS), along with a method pioneered by Angus Deaton (1988, 1989, 1997), to estimate alcohol elasticities for South Africa. Below, we briefly discuss the method, together with a brief discussion of the data. Technical details about the method are contained in Appendix C of this report.

The challenge in estimating demand elasticities in Low and Middle-Income Countries (LMICs) has been the absence of relevant data. Resource-constrained statistical agencies often do not collect consumption and price data over a sufficient timespan to allow for the estimation of defensible price elasticities. The genius in the method pioneered by Angus Deaton is that analysts can use household expenditure surveys, which are available in abundance in many LMICs, to estimate such elasticities. Price data, often not explicitly collected in these surveys, can be inferred from consumption and expenditure data, which typically *are* collected in such surveys.

A second challenge with demand estimation is reverse causation, sometimes referred to as simultaneity bias. We know that price and demand (or consumption) are negatively related, according to the law of demand. What is not often clear is the direction of causation: does consumption influence price or does price influence consumption? Resolving this is of cardinal importance because demand elasticities, and, by consequence, demand control measures, pre-suppose that price influences demand. The analyst, therefore, needs to ensure that the estimated elasticities are the result of the correct chain of causation. Deaton's method assures this by utilizing the empirical fact that prices of most goods in LMICs are heavily influenced by transportation costs. The implication of

this is that price is significantly influenced by non-demand factors, allowing for the estimation of its pure impact on demand. Further details on Deaton's method are contained in Appendix C.

The data for this study come from Waves 1, 3 and 4 of the National Income Dynamics Study (NIDS) collected by the Southern Africa Labour and Development Research Unit (SALDRU) at the University of Cape Town. NIDS is a nationally representative household panel study that tracks individuals and households over time. In its inaugural wave (Wave 1 of 2008), the sample size was 7300 households. For Wave 3 (2012) and Wave 4 (2014) the sample sizes were respectively 10200 and 11800 households. We do not analyse data from Wave 2 (2010) and Wave 5 (2017) in this study. Wave 2 data has some acknowledged data quality issues and Wave 5 lacks some crucial variables on alcohol consumption.

NIDS collects an exhaustive list of data on the social and economic conditions, labour market outcomes and expenditure patterns of South African households. In the expenditure module of the survey, households are asked whether they spent any money on alcohol and, if so, how much. In the individual questionnaire of the survey, adults in the household (aged 15 years or older) are asked questions on the frequency (days per week) and quantity (in standard drinks) of alcohol consumption. NIDS defines a standard drink as a "small glass of wine; a 330ml can of regular beer, a tot of spirits or a mixed drink" (National Income Dynamics Study, 2015, p56). The quantity of alcohol consumed in a specified time period is aggregated across all members of the household and we use this, alongside household expenditure, to obtain "unit values" of alcohol. One can regard, heuristically, the unit value as the average price paid per unit of alcohol, but the literature prefers the term "unit value". We keep to this convention in this report. The unit values and the alcohol consumption by the household are used to derive price elasticities of demand for alcohol. All of our analysis is conducted at the household level.

All households that report that they consume alcohol are categorized into one of three drinker types using household-level consumption patterns. We categorize households as "binge drinking households" if occupants in that household infrequently drink (up to twice a week), but drink a lot when they do (5 or more standard drinks per session). A technically more accurate term for these drinkers would be "*irregular* heavy episodic drinkers", but, as a shorthand, we refer to them as "binge drinkers". We categorize households as "other heavy drinking households" if household members drink often (more than twice a week) and drink a lot when they do (two or more standard drinks per session). "Other heavy drinking households" thus also include those households who binge on a regular basis. The third categorization is for "moderate drinking households", whose members declare that they drink alcohol, but who are not binge drinkers or other heavy drinkers. These would typically be households that drink four or fewer standard drinks on an irregular basis (i.e. two times or less a week, or who drink two or fewer standard drinks on a regular basis).

Our categorization of binge drinking comes close to the one favoured by the Centers for Disease Control and Prevention (CDC). For the CDC, binge drinking is defined as "consuming 5 or more drinks for men or 4 or more for women in about 2 hours" (CDC, 2018). Unfortunately NIDS does not collect information on consumption per hour but does so for a "typical drinking day" and we use this, together with frequency of drinking, to identify binge drinking households.

Table 5 gives a breakdown of the share of each household type as a percentage of all drinking households (top panel) and as a percentage of total alcohol consumed (bottom panel) for the three waves.

Table 5: Share of different types of drinking households

Percentage of drinking households classified as	Wave 1	Wave 3	Wave 4
Binge drinking households	17.7	17.3	19.4
Other heavy drinking households	10.6	9.3	9.9
Moderate drinking households	71.7	73.4	70.7
Total	100.0	100.0	100.0
Percentage of total volume of alcohol consumed by:			
Binge drinking households	24.2	24.8	27.3
Other heavy drinking households	47.7	51.2	50.3
Moderate drinking households	28.1	24.0	22.5
Total	100.0	100.0	100.0

Source: NIDS.

The majority of alcohol consumption, as reported by NIDS, is by other heavy drinking households. These households consume about 50% of all alcohol consumed in the country. The most common type of drinking household, however, is the moderate drinking household, which comprises about 72% of all drinking households. Binge drinking households consume about a quarter of all alcohol and constitute a little below 20% of all drinking households.

Table 6 presents results for the price elasticities of demand for the overall samples and for the three different drinker types. The table also reports whether an estimate is statistically significant using the conventional thresholds of 1% (***), 5% (**) and 10% (*). As well as these, we also report standard errors, confidence intervals and sample sizes (referring to the number of clusters and not number of households). In order to improve the statistical power of the results, the analysis was performed for the country as a whole, not just the Western Cape. Deriving estimates for the Western Cape alone would involve the use of very small sample sizes resulting in statistically unreliable estimates. In any case, the elasticity estimates derived for the country as a whole are generalizable to the Western Cape. Technical details on how these elasticities are derived are discussed in full in Appendix C.

The full sample price elasticities, calculated separately for each wave, are similar across the three waves (their confidence intervals overlap one another) and are in line with much of the literature reviewed in Section 3 above. The average elasticity from the three waves is -0.54, similar to the consensus estimates in the international literature. The implication of this estimate is that alcohol demand is price inelastic in South Africa – a 10% increase in alcohol prices leads to a 5% reduction in alcohol demand.

Of the different drinker types, we find that the demand for alcohol by other heavy drinking households is consistently less price elastic (i.e. more price inelastic) than that of moderate drinking households. The average elasticity for other heavy drinking households varies between -0.15 and -0.19 across the three waves, which is in line with the findings in the international literature. For moderate drinking households, the price elasticity estimates vary between -0.34 and -0.47 across the three waves, a finding that is also in line with the international literature.

For binge drinking households we find that, for waves 1 and 3, these households respond less to price changes than the overall sample, with an average for the two waves centring around -0.2, an estimate that is on the lower end of the wide range of estimates in the literature. The estimate for Wave 4 is

unfortunately estimated with much error (very high standard errors relative to waves 1 and 3) and is therefore not statistically reliable (nor shown here).

The careful reader would notice that the price elasticity of demand for the full sample is somewhat higher (in absolute terms) than the price elasticities of any of the sub-categories. This anomaly, related to different sample compositions, is explained in Appendix C, but our study is not unique in this finding.

Table 6: Estimates of the price elasticity of demand for alcohol for different samples and waves

		Wave 1	Wave 3	Wave 4
Full Sample	Price Elasticity	-0.491***	-0.474***	-0.688***
	Standard Error	0.017	0.011	-0.208
	Confidence Int.	(-0.548, -0.434)	(-0.496, -0.454)	(-1.094, -0.281)
	Sample Size	323	355	378
Binge drinking Households	Price Elasticity	-0.273***	-0.167***	(Positive sign but Insignificant)
	Standard Error	0.017	0.007	
	Confidence Int.	(-0.305, -0.240)	(-0.180, -0.154)	
	Sample Size	129	191	
Other Heavy drinking Households	Price Elasticity	-0.188**	-0.187***	-0.154***
	Standard Error	0.094	0.033	0.009
	Confidence Int.	(-0.372, -0.005)	(-0.252, -0.123)	(-0.172, -0.135)
	Sample Size	88	124	146
Moderate drinking Households	Price Elasticity	-0.466***	-0.339***	-0.441**
	Standard Error	0.046	0.014	0.225
	Confidence Int.	(-0.555, -0.376)	(-0.366, -0.312)	(-0.882, -0.001)
	Sample Size	290	337	364

Notes: The method for deriving the elasticities is discussed in detail in Appendix C. ***, **, * signify statistical significance at the 1%, 5% and 10% levels respectively. The sample size does not refer to the number of households but to the number of clusters (see Appendix C for details).

In conclusion, we find overall elasticity estimates for South Africa to be in line with international literature – alcohol consumption responds to price changes in South Africa much as it does internationally. In terms of sub-groups of the drinking population, we find that other heavy drinking households respond the least to price changes, especially compared to moderate drinking households. In response to a 10% increase in alcohol prices, binge drinking households decrease their alcohol consumption by somewhat more than 2%, heavy drinking households by somewhat less than 2%, and moderately drinking households by about 4%.

5. Simulating the impact of a provincial excise tax on alcohol for the Western Cape

In this section we present the results of a simulation modelling exercise in which we investigate the likely consequences of a provincial excise tax aimed at reducing the demand for alcohol in the Western Cape. This discussion is a short version of a much more detailed and nuanced discussion in Appendix D. We urge interested readers to refer to the appendix to understand the simulation model that

underlies this analysis better. In the following section we present the results of a simulation exercise in which we investigate the impact of a minimum unit price on the demand for alcohol.

Performing a simulation exercise consists of a few chronological steps. In the first step, one creates a base scenario that reflects reality as well as possible. In the second step one "shocks" the system by changing something – in this instance by introducing a provincial excise tax. One allows the shock to influence all the variables of interest, in this case the price of alcohol, alcohol consumption and excise tax revenue. In the third step, one compares the new values of the variables of interest with the variables in the base scenario and evaluates the results.

For the country as a whole, a total of 315.7 million litres of absolute alcohol were consumed in the 2017/18 financial year, of which 48.6% was beer, 39.7% was "wine and other fermented beverages" (henceforth termed "wine"), and 11.7% was spirits. The share of the Western Cape in South Africa's total alcohol consumption is estimated at 15%. The composition of the alcohol basket of the Western Cape differs somewhat from the rest of the country. The Western Cape consumes a substantially higher relative share of wine, a substantially lower relative share of beer, and a slightly lower relative share of spirits than the country as a whole.

We estimate that binge drinkers consume an estimated 25.4% of total alcohol, other heavy drinkers consume 49.7%, and moderate drinkers consume the remaining 24.9%.

Table 7 presents our best estimate of alcohol consumption (expressed in litres of absolute alcohol) in the Western Cape, broken down by beverage category and type of drinker. This table forms the base scenario for alcohol consumption in the Western Cape.

Table 7: Quantities of absolute alcohol consumed by different groups of drinkers in the Western Cape (million litres)

	Beer	Wine	Spirits	Total
Binge drinkers	5.61	5.37	1.05	12.03
Other heavy drinkers	8.62	11.22	3.70	23.54
Moderate drinkers	5.48	5.98	0.33	11.79
Total	19.71	22.58	5.07	47.35

Notes: Please note that these numbers are subject to assumptions described in the text, which can be changed by the user. The numbers are based on data obtained from the National Treasury (2018), NIDS waves 1, 3 and 4, and AMPS, 2014.

The crucial variable in the analysis is the price of alcohol. Based on the excise taxes set at national level, and the targeted tax burdens set by National Treasury on the three different alcohol categories, we estimate that the average price is R14.75 per 750 ml bottle of beer, R27.19 per bottle of wine and R161.63 per bottle of spirits. The retail price can be decomposed into three components: value-added tax (VAT), the excise tax, and the net-of-tax price. Table 8 decomposes the retail price (expressed in litres) into these three cost components. The retail prices are set such that the total tax burden (i.e. the sum of excise tax and VAT, divided by the retail price), is 35% for beer, 23% for wine and 48% for spirits. These tax burden targets were set by National Treasury in 2012.

Table 8: Decomposition of the average retail price in the base scenario (per litre), in 2017/18

	Beer	Wine	Spirits
Net-of-tax price	12.79	27.92	112.06
Excise tax (national)	4.32	3.61	75.33
Excise tax (provincial)	0	0	0
VAT	2.57	4.73	28.11
Average retail price (per litre)	19.67	36.26	215.50
Average retail price (per 750 ml)	*14.75*	*27.19*	*161.63*
Excise tax burden	22.0	10.0	35.0
Total tax burden	35.0	23.0	48.0

The introduction of a provincial excise tax is expected to raise the retail price of alcohol. We assume, for the benefit of the exposition, that the Western Cape Government levies a provincial tax of R20 per litre of absolute alcohol for beer, R1.00 per litre of beverage for wine (irrespective of alcohol content) and R50 per litre of absolute alcohol for spirits. These are arbitrary numbers and do not necessarily reflect the current intentions of the Western Cape Government. However, it is easy to change the size of the proposed provincial tax in the Excel sheet, and the model will automatically recalculate all the variables of interest.

Depending on the market power of the firms that produce and sell alcoholic beverages, it is possible for them to increase (or decrease) the net-of-tax price in response to the imposition of the provincial excise tax. Most simulation exercises assume that the producers increase the retail price by the full amount of the excise tax. However, where firms have substantial market power, as is the case in the alcohol industry in South Africa, firms often increase the net-of-tax price in response to the increase in the excise tax. We assumed, somewhat arbitrarily, that producers would increase the net-of-tax price of beer by 5%, wine by 3% and spirits by 2% in response to the imposition of the provincial excise tax.

The composition of the retail price after the imposition of the provincial excise tax and the change in the net-of-tax price is shown in Table 9. Comparing Table 9 with Table 8 indicates that these changes to the retail price components have increased the price of beer by 9.6%, the price of wine by 5.8%, and the price of spirits by 12.7%

Table 9: Decomposition of the average retail price after the imposition of a provincial excise tax (per litre), using 2017/18 values

	Beer	Wine	Spirits
Net-of-tax price	13.43	28.76	114.30
Excise tax (national)	4.32	3.61	75.33
Excise tax (provincial)	1.00	1.00	21.50
VAT	2.81	5.00	31.67
Average retail price (per litre)	21.56	38.37	242.80
Average retail price (per 750 ml)	16.17	28.78	182.10
Excise tax burden	24.7	12.0	39.9
Total tax burden	37.7	25.1	52.9

Notes: The assumed provincial excise tax is R20 per litre of absolute alcohol for beer, R1.00 per litre of wine and R50 per litre of absolute alcohol for spirits

The pivotal link between the change in the price of the beverage and the change in consumption is the price elasticity of demand. Based on the analysis presented in section 4, we used a price elasticity of demand of -0.22 for binge drinkers, -0.18 for other heavy drinkers and -0.4 for moderate drinkers. Applying these price elasticities of demand to the price changes calculated in Table 9 yields the percentage change in consumption. This is shown in Table 10.

Table 10: Percentage change in alcohol consumption in the Western Cape after the imposition of a province-specific excise tax

	Beer	Wine	Spirits	Total
Binge drinkers	-2.1	-1.3	-2.8	-1.8
Other heavy drinkers	-1.7	-1.0	-2.3	-1.5
Moderate drinkers	-3.8	-2.3	-5.1	-3.1
Total	-2.4	-1.4	-2.6	-2.0

The provincial excise tax is predicted to decrease alcohol consumption among all groups (-1.8% for binge drinkers and -1.5% for other heavy drinkers), but it is expected to have the largest impact on moderate drinkers' consumption (-3.1%). The fact that alcohol consumption by moderate drinkers decreases by a larger percentage than that of other categories of drinkers is unsurprising, as moderate drinkers are more price sensitive than binge drinkers and other heavy drinkers.

Population-based interventions like excise tax increases on "sin goods" can be very effective in changing behaviour and reducing the consumption of the targeted product. However, they are often criticised as blunt instruments. We see this here as well. Even though the provincial tax is targeted towards binge and other heavy drinkers, and is successful in reducing their consumption by some margin, the biggest impact is on moderate drinkers, who are not specifically targeted by the intervention.

In concluding this section, we consider the revenue aspects of the excise tax. Based on the previous analysis, one can easily calculate the various stakeholders' revenue shares and their revenue amounts by multiplying the appropriate tax or price component with the quantity. The base scenario for the Western Cape is shown in Table 11.

Table 11: Alcohol-related revenues based on consumption in the Western Cape, in the base scenario (R millions)

	Beer	Wine	Spirits	Total
Industry revenue (based on net-of-tax price)	5 040	5 254	1 321	11 614
Excise tax revenue (national)	1 702	679	888	3 269
Excise tax revenue (provincial)	0	0	0	0
VAT	1 011	890	331	2 233
Total expenditure by consumers	7 753	6 823	2 540	17 116

In Table 12, we estimate the revenues after the imposition of a provincial excise tax and also assuming that the alcohol industry has increased the net-of-tax price by a small percentage.

Table 12: Alcohol-related revenues based on consumption in the Western Cape, after the imposition of a provincial excise tax (R millions)

	Beer	Wine	Spirits	Total
Industry revenue (based on net-of-tax price)	5 163	5 333	1 313	11 809
Excise tax revenue (national)	1 661	670	865	3 196
Excise tax revenue (provincial)	385	185	247	817
VAT	1 081	928	364	2 373
Total expenditure by consumers	8 291	7 116	2 788	18 195

From the perspective of the Western Cape Government, the excise tax revenue that accrues to the province is probably the single most important parameter of concern. In this example (a beer tax of R20 per litre of absolute alcohol, a wine tax of R1.00 per litre of beverage and a spirits tax of R60 per litre of absolute alcohol), the Western Cape Government can expect to raise R817 million. Of course, the amount of revenue raised by the provincial government is a function of the level of the excise tax imposed.

The Western Cape Government, like all provincial governments in South Africa, does not have much power to raise its own revenues. Because it experiences a net inflow of people from other provinces, it is under pressure in its provision of health, education and other social services. Provincial governments get their budget allocation from National Treasury, based on the "equitable share" formula. The formula works against provinces that experience a net inflow of people, as the share of revenue is based on the size of the population at a previous time, and does not take migration into account. This means that the Western Cape (like other provinces that experience a net inflow of people) is relatively disadvantaged compared to provinces that experience a net outflow of people.

Raising nearly R1 billion a year in the form of a provincial excise tax on alcohol would most certainly relieve much pressure on the Western Cape Government's budget. This money could be used for socially desirable spending. However, as will be pointed out in Section 7, there are a number of administrative and practical issues that would make the practical implementation of the provincial excise tax difficult.

From National Treasury's perspective, the introduction of a provincial excise tax would result in a modest decrease in excise tax revenue to the national government. However, this decrease in excise tax revenue is more than compensated for by an increase in alcohol-related VAT revenue. This finding is true for all realistic price elasticity and industry price response scenarios, and is not just a peculiarity of this set of parameters.

Other than raising revenue for the province, a provincial tax would reduce alcohol consumption across the board. A reduction in binge and other heavy drinking can be expected to reduce some of the acute and chronic consequences of alcohol abuse. A reduction in moderate drinking is likely to cause a reduction in some of the long-term negative health consequences associated with alcohol, based on the finding that the net health effect of alcohol use, even among moderate drinkers, is negative (Griswold et al., 2018; Wood et al., 2018)

Detractors of a provincial excise tax on alcohol would argue that the cost of implementing such a tax is too high. The relatively large reduction in alcohol consumption by moderate drinkers could be regarded as an unacceptable "by-product" of a policy that aims to target binge and other heavy drinkers. As technical economists, we are not in a position to judge this argument, other than noting that it is likely to be made and that the Western Cape Government would have to address it. In the following section we want to analyse a different price-related intervention that does not have the revenue implications of a provincial excise tax, but that is more targeted at curbing alcohol use among binge and other heavy drinkers.

6. Simulating the impact of a minimum unit price on alcohol consumption in the Western Cape

Recently, regulations that make all alcohol sold in Scotland subject to a minimum unit price, set at 50 pence per unit of alcohol (about 8 grams), became effective. These regulations have been in preparation for more than six years, and, despite strong opposition by the alcohol industry, and a protracted legal battle, became effective in May 2018. The explicit aim of the minimum price is to reduce abusive drinking in Scotland.

The rationale for a minimum unit price is based on the empirical finding that most very cheap alcohol is consumed in an abusive way. For example, in the Western Cape there are a number of producers of cheap sugar-fermented alcohol that is sold in large containers to poor wage earners and other low socioeconomic groups. This is the only kind of alcohol that these people can afford and it is highly effective in making people drunk.

Worldwide, heavy drinkers tend to drink cheaper, often more potent, alcohol than moderate drinkers do (Gill et al., 2015; Cousins et al., 2016; Gill et al., 2017). Using NIDS data, we found very strong evidence that this is true for South Africa as well. In Table 13 we show what percentage of alcohol consumed by different categories of drinkers (i.e. binge drinkers, other heavy drinkers and moderate drinkers) is purchased at a unit value (roughly translated as price) at different percentages of the "overall median unit value". The detail of the derivation of this table is provided in Appendix E. This table is based on consumption of alcohol in the whole of South Africa.

Table 13 shows that heavy drinkers consume a disproportionate volume of alcohol at very low unit values. In fact, in 2014 more than half (52.8%) of all alcohol consumed by heavy drinkers had a unit value of less than 60% of the overall median unit value. In contrast, only 13.9% of alcohol consumed

by binge drinkers, and 5.2% of alcohol consumed by moderate drinkers had a unit value of less than 60% of the overall median unit value.

Table 13: Percentage of total consumption consumed by different categories of alcohol consumers at unit values less than a specific percentage of the overall median unit value (all of South Africa)

	Binge drinkers			Other heavy drinkers			Moderate drinkers		
Percentage of the median	2008 (W1)	2012 (W3)	2014 (W4)	2008 (W1)	2012 (W3)	2014 (W4)	2008 (W1)	2012 (W3)	2014 (W4)
<20%	6.1	2.7	1.1	18.9	25.3	21.8	2.8	1.2	0.2
<40%	11.4	4.7	6.4	34.4	47.3	41.7	6.5	3.3	0.8
<50%	16.2	6.4	11.6	37.5	54.6	46.4	7.7	4.2	0.9
<60%	24.6	10.3	13.9	46.8	58.2	52.8	10.4	5.4	5.2
<80%	28.6	18.9	20.6	64.3	74.1	67.0	16.1	10.9	8.2
<100%	37.0	24.6	26.9	73.9	80.4	79.5	21.0	12.2	13.0
<120%	44.1	37.1	28.3	78.5	81.6	86.6	22.5	15.4	16.2
<140%	50.9	40.9	38.9	80.4	84.8	89.4	26.6	21.7	17.5
<160%	55.4	46.9	43.4	84.0	85.8	91.8	31.2	22.9	20.4

Source: NIDS wave 1, 3 and 4

Table 13 is compiled for the country as a whole. In Table 14 we present the same analysis for the Western Cape. The picture is very similar. However, because there are substantially fewer observations for the Western Cape than the country, the data is “coarser” and more subject to the influence of one or more influential observations and outliers.

Table 14: Percentage of total consumption consumed by different categories of alcohol consumers at unit values less than a specific percentage of the overall median unit value (Western Cape only)

	Binge drinkers			Other heavy drinkers			Moderate drinkers		
Percentage of the median	2008 (W1)	2012 (W3)	2014 (W4)	2008 (W1)	2012 (W3)	2014 (W4)	2008 (W1)	2012 (W3)	2014 (W4)
<20%	10.6	10.8	2.2	32.8	61.8	39.6	0.0	0.1	0.2
<40%	20.1	23.6	14.9	48.6	78.4	53.9	0.3	3.4	5.1
<50%	20.9	34.3	20.3	51.5	81.7	55.6	2.2	3.6	8.9
<60%	27.1	35.2	24.6	55.2	83.1	66.6	16.4	6.1	9.1
<80%	33.4	42.2	24.9	66.0	83.1	91.9	21.3	11.6	12.7
<100%	54.7	46.1	33.5	80.9	83.3	93.8	26.6	13.0	13.0
<120%	57.8	48.6	36.7	87.7	92.7	97.3	32.4	30.5	20.1
<140%	67.8	65.4	38.7	94.5	92.9	97.3	42.0	34.8	26.6
<160%	68.4	69.0	44.7	94.5	96.7	97.3	45.9	35.1	29.9

A minimum unit price will have an effect on the price/unit value of the cheapest product, but it does not have an effect on the price of alcohol that is sold at higher unit values. For the sake of exposition, and because of data constraints, we assume that the Western Cape Government (or the National Government) sets the minimum price (unit value) as a percentage of the overall median unit price. We are not in a position to make suggestions about the minimum price levels for individual alcoholic beverages. The level at which the minimum unit price should be set is to be determined by the Western Cape Government/National Government. For illustrative purposes, we set the minimum price equal to 50%, 70% and 100% of the overall median unit value.

The higher unit values/prices will reduce consumption. The magnitude of the decrease in consumption is determined by the price elasticity of demand. For the three categories of consumers, we use the price elasticities that were estimated in section 4, namely -0.22 for binge drinkers, -0.18 for other heavy drinkers and -0.4 for moderate drinkers. The expected percentage decrease in consumption, for the three categories of drinkers (i.e. binge, other heavy and moderate drinkers), the three years of data (i.e. 2008, 2012 and 2014), and the three levels of the minimum unit price (i.e. 50%, 70% and 100% of the overall median unit value) for the country as a whole are shown in Table 15, while the same analysis is shown for the Western Cape in Table 16.

Table 15: Predicted percentage change in consumption in response to the imposition of a minimum unit price equal to various percentages of the overall median unit value of alcohol (All of South Africa)

	Binge drinkers	Other heavy drinkers	Moderate drinkers	Total
Minimum price equal to 50% of the overall median unit value				
Wave 1 (2008)	-1.60	-4.53	-1.75	-3.10
Wave 3 (2012)	-0.70	-5.42	-0.86	-3.09
Wave 4 (2014)	-0.77	-4.66	-0.17	-2.55
Minimum price equal to 70% of the overall median unit value				
Wave 1 (2008)	-2.81	-6.06	-2.73	-4.41
Wave 3 (2012)	-1.27	-7.48	-1.37	-4.38
Wave 4 (2014)	-1.62	-6.55	-0.63	-3.82
Minimum price equal to 100% of the overall median unit value				
Wave 1 (2008)	-4.46	-8.34	-4.27	-6.34
Wave 3 (2012)	-2.41	-9.99	-2.50	-6.20
Wave 4 (2014)	-2.87	-8.94	-1.52	-5.55

Table 16: Predicted percentage change in consumption in response to the imposition of a minimum unit price equal to various percentages of the overall median unit value of alcohol (Western Cape only)

	Binge drinkers	Other heavy drinkers	Moderate drinkers	Total
Minimum price equal to 50% of the overall median unit value				
Wave 1 (2008)	-3.22	-6.83	-0.05	-4.22
Wave 3 (2012)	-4.10	-10.37	-0.33	-6.28
Wave 4 (2014)	-1.48	-8.02	-0.72	-4.54
Minimum price equal to 70% of the overall median unit value				
Wave 1 (2008)	-4.49	-8.43	-1.21	-5.63
Wave 3 (2012)	-5.96	-12.88	-0.97	-8.16
Wave 4 (2014)	-2.91	-9.87	-1.75	-6.08
Minimum price equal to 100% of the overall median unit value				
Wave 1 (2008)	-6.14	-10.28	-3.75	-7.60
Wave 3 (2012)	-8.07	-15.07	-2.31	-10.12
Wave 4 (2014)	-4.34	-12.86	-3.09	-8.26

Although the impact on consumption differs from wave to wave, a consistent finding is that the imposition of a minimum unit price has the greatest impact on heavy drinkers. In fact, if the minimum unit price is set at 50% of the overall median unit value, the model predicts a 5% and 8% decrease in alcohol consumption by heavy drinkers in the country and in the Western Cape, respectively. If the minimum price is set at 70% of the overall median unit value, the decrease is about 6.5% in the country and about 10% in the Western Cape, and if it is set at 100% of the overall median unit value the decrease in consumption is about 9% in the country and 13% in the Western Cape.

The impact of the minimum unit price on binge drinkers and moderate drinkers for the country as a whole (Table 15) is broadly similar, especially for wave 1 (2008) and wave 3 (2012) data. For the 2014 data, the impact of a minimum unit price on binge drinkers' alcohol consumption is substantially greater than on moderate drinkers' consumption. However, for the Western Cape, the impact of the minimum unit price is substantially more on binge drinkers than on moderate drinkers. Although there is some variation between the different waves, it would be fair to say that the imposition of a minimum unit price in the Western Cape is likely to reduce the volume of alcohol consumed by binge drinkers by at least twice the percentage than what it would reduce the volume of alcohol consumed by moderate drinkers.

Our analysis suggests that a minimum unit price is a much sharper and more targeted instrument than the imposition of a provincial excise tax. This is true for the country as a whole, but it is especially true for the Western Cape. Whereas a provincial excise tax caused the largest decrease in alcohol consumption among moderate drinkers, a minimum unit price has by far the biggest impact on heavy drinkers. Moderate drinkers are substantially less affected by a minimum unit price than by an excise tax.

The drawback of a minimum unit price is that it yields no revenue for the government. The extra profits go into the pockets of the alcohol industry, although, as we point out in the next section, economic theory predicts that these extra profits might be transitory.

Our minimum price analysis leaves a number of issues unanswered. For example, the drawbacks in the data do not allow us to state what the actual real-world minimum unit price should be. For example, we cannot say that the minimum unit price should be R4 or R6 per drink (or drink equivalent). That is a matter that should be resolved by doing a survey of prices of alcoholic beverages, especially at the low end of the price spectrum.

However, we recommend that if the Western Cape Government does implement a minimum unit price policy, that it is based on the alcohol content, rather than on the volume of beverage. It is the alcohol content that causes the damage, and the minimum unit price would have to be targeted with that consideration.

7. Other factors to take into consideration

The focus of this report is on the economics of using price-based measures to reduce harmful drinking in the Western Cape. However, we fully appreciate that policies have multiple dimensions and that policy makers should take cognizance of them. Even though a policy might be economically justified and well-argued, political, social and administrative dynamics might prevent the successful implementation of such a policy. In this section we present some of the issues that we identified as factors that could have an impact on the successful implementation of a provincial excise tax on alcohol and/or a provincial minimum unit price on alcohol. The discussion starts with factors that we believe may mediate the successful implementation of a provincial excise tax, and then moves to a discussion of the implementation of a provincial minimum unit price. There are some aspects that can have an impact on both these interventions.

a. Legislative possibility

Currently no province in South Africa has implemented a provincial *excise tax* or levy on alcohol (or tobacco products, for that matter). The Western Cape has tried for many years to implement a provincial levy on petroleum products, but this was ultimately unsuccessful. The successful implementation of a provincial excise tax on alcohol in the Western Cape would be unprecedented.

Similarly, we are not aware of any province that has implemented a *minimum unit price* on alcohol, or any other "sin" product. The Tobacco Institute of Southern Africa (TISA) has, for a number of years, lobbied for a minimum retail price on cigarettes at the national level, but they have not yet been successful.

As economists, we do not have specialised legal or constitutional expertise as to the legal capacities of provinces to impose provincial taxes. We requested a legal opinion from one of the leading law firms, and this is attached as Appendix F. Our interpretation of the legal opinion is that the Constitution allows for a provincial excise tax or levy, but that it would have to be approved by the national government. Of course, with the political dynamics as they are, this could be problematic, but we are not in a position to offer an informed view on this.

b. Social acceptability of a provincial excise tax

People do not like paying taxes. This is true for income tax, but also for indirect taxes, like VAT and excise taxes. Consider the following three examples. First, the increase in the VAT rate from 14% to 15% in April 2018 was met with much opposition from the public. Second, every year, the increase in the excise tax on "sin goods" is lamented in the media. Third, the Organisation Undoing Tax Abuse (OUTA) has been very vocal in its opposition to e-tolls in Gauteng and other forms of what they regard as excessive and unfair taxation. These examples all point to the fact that taxes are unpopular, especially when there is a perception that the revenue is not used well.

A provincial excise tax on alcohol would be strongly opposed, not only by the industry (see below) but also by large portions of the community. "Selling" the concept to the public would have to be done very carefully and strategically.

In this regard it is instructive to consider the experience of other countries with tobacco excise taxes. Tobacco is taxed quite heavily by many countries, although there is substantial room for further increases in most countries. A number of countries have been able to increase public support for tobacco tax increases by earmarking the additional revenues for specific projects, often aimed at the poor and the marginalised. For example, the "sin tax reform" that has been implemented in the Philippines since 2012 received significant public support because the additional revenues were used to improve the public health system, ensuring that the poorest 40% of the population received universal health coverage (Kaiser et al., 2016). Also, some of the revenues were targeted at tobacco farmers who might be disadvantaged by the higher taxes.

Earmarking of tax revenue is anathema to National Treasury. Although public health and anti-tobacco organisations in South Africa have lobbied for dedicated funding from tobacco taxes to fund public health initiatives, this has been strongly resisted by National Treasury. However, to the extent that earmarking would be possible and politically feasible at a provincial level, the Western Cape Government could consider linking the revenue of a provincial excise tax to highly visible and popular expenditure programmes to increase the public support for such an intervention.

c. Industry opposition

The alcohol industry in South Africa is powerful and influential. They certainly will not agree to a provincial excise tax, and will oppose it with great force. For example, in a slightly different context, when the Minister of Health considered legislation to restrict alcohol advertising and marketing, the alcohol industry opposed the legislation with such force that these plans seem to be all but dead.

The introduction of an excise tax on sugar-sweetened beverages (SSBs) was met with a similar level of opposition by the SSB industry. Touching an important nerve for South African society – unemployment - the industry initially claimed that the SSB tax would result in 60 000 job losses (Benade and Essop, 2017). The industry argued that the supposed benefits of the excise tax (i.e. reduced levels of obesity) were too small in comparison to the cost that the excise tax would impose on the economy (e.g. job losses and loss of GDP), and that other interventions (like education) would be more effective. Anecdotally, the media was divided on the matter, and the tax measures did not receive much public support. Many people perceived the SSB tax to be less of a public health intervention than a means for the cash-strapped National Treasury and South African Revenue

Services to extract more revenue from the population. The resistance and "controversy" initiated by the industry led to a one-year delay in the implementation of the SSB tax and a substantial dilution of the excise tax, relative to its original structure and level.

The Western Cape Government can expect extremely strong industry opposition to a provincial excise tax. The Western Cape is home to South Africa's well-established wine industry. The industry would probably argue that the excise tax would destroy one of the most important economic sectors of the Western Cape. While this would be a wildly exaggerated claim, it will be made, and some people will believe it. The public health argument, and the fact that alcohol misuse is responsible for untold misery and many social and economic problems in the Western Cape, would probably get less attention than the economic argument.

d. Drinking in other provinces

While the focus of this report is on the Western Cape and flows from the Western Cape Government's Alcohol-related Harms Reduction White Paper, the problem of alcohol misuse is not restricted to the Western Cape only. In fact, according to the statistics presented in Section 2 of the report, alcohol use in some of the other provinces, notably the Northern Cape, North-West, the Free State and Gauteng, is at a similar or even higher level than in the Western Cape. One can legitimately ask the question: given that alcohol use and misuse is so widespread in the country, should the response to alcohol misuse not be at the national level, rather than at the provincial level?

The authors of the White Paper argue that the Western Cape Government should lobby National Treasury to increase the excise tax nationally. An increase in the national excise tax will most certainly have a positive public health impact on the Western Cape. The National Treasury currently has a well-defined policy for alcohol taxation, where the National Treasury sets the tax amount (which is levied as a specific tax) such that it meets a certain total tax burden percentage. Every year the level of the specific tax is adjusted to maintain the tax burden percentage.

These targeted tax burdens are not cast in stone. In fact, in 2012 the targeted tax burden was increased from 33% to 35% for beer and from 43% to 48% for spirits (it remained at 23% for wine) (National Treasury, 2014a). Alcohol taxation has proven itself to be a reliable and predictable source of revenue for the government over the past years, even when other revenue sources faltered. Within the context of a government that is in a fiscal crisis and faces a large shortfall, now is an appropriate time to lobby National Government for a structural increase in the excise tax on alcohol products. While National Treasury's rationale for increasing the tax on alcohol would currently be driven more by fiscal than public health concerns, the fact of the matter is that both causes will be served by a tax increase.

From a political and administrative perspective, an increase in the national excise tax on alcohol by National Treasury would be easier than having a provincial government implement a provincial tax. To increase the excise tax at a national level is administratively very easy; it happens on an annual basis. To implement a new provincial tax, especially where there is no precedent for such a tax, would be difficult and cumbersome.

e. Tax administration issues

Currently the excise tax on alcohol is collected from the producer by SARS. Since the number of producers (and importers) of alcohol, especially beer and spirits, is small, it is cheap and administratively easy to collect the excise revenue. It does not matter where in the country (or, for that matter, where in the Southern African Customs Union (SACU) member states) the alcohol is consumed; the tax is levied at source. There is free movement of goods over provincial borders.

The fact that goods could be produced in one province but are consumed in another province poses a very real, and possibly insurmountable, obstacle to a province that wants to implement a provincial excise tax. In the absence of a Track and Trace system, a producer of alcohol in the Western Cape currently does not know where in South Africa the alcohol is consumed. There is currently no legal obligation for the producer to know where in South Africa the product is consumed. While Track and Trace systems exist to allow the tracking and tracing of goods, they are not currently in place in South Africa. To require alcohol producers to implement a Track and Trace system, just for the purposes of implementing a provincial excise tax, seems economically unjustified.

The fact that the Western Cape is a major producer of wine and wine-based products, and "exports" a large proportion of this wine to other provinces, would make it very difficult to implement a provincial excise tax.

The Western Cape Government could decide to tax the alcohol produced in the Western Cape, at source, irrespective of where in the country it is consumed. In such a case, the tax would probably be perceived as a tax on doing business in the Western Cape. The will lead to the perception that the Western Cape is unfriendly to business, which is an image that the Western Cape Government certainly does not want. The tax would no longer be seen as a health promotion levy, but rather as a punitive tax.

While many alcohol producers (such as wine estates) would not be able to avoid the provincial tax, at the margin it will discourage alcohol producers from settling in the Western Cape. It might also encourage unproductive rent-seeking and tax-avoidance behaviour. For example, some alcohol producers might set up bonded warehouses in the Northern Cape or the Eastern Cape. They would transport the alcohol to the warehouse across the provincial border, declare the goods for excise at that point, and transport them back into the Western Cape. A tax should not create such incentives.

f. Collection of the revenues

Currently SARS collects most of the tax revenues in South Africa. The provinces have very limited ability to collect revenue, because they do not have much authority to raise their own revenue. Assuming that the Western Cape is able to overcome the other hurdles described in this section and imposes a provincial excise tax on alcohol, through what institution will it collect the excise taxes? As has been discussed, it would be very difficult to collect the taxes at source, given that there is free movement of goods across provincial borders.

If the tax is to be a tax on alcohol consumption in the Western Cape, it would have to be levied at the retail level. As it is, alcohol outlets are supposed to be licenced with the Western Cape Government, but presumably not for excise tax purposes. It would require a substantial institutional (and possibly legal) investment for the Western Cape to create this infrastructure. Furthermore having to register

at two tax collecting agencies, would increase the bureaucratic burden on the alcohol retail outlets, and would probably create the impression that the Western Cape is unfriendly to business.

Another option would be for SARS to collect the excise taxes on behalf of the Western Cape Government. However, if the excise tax were to be collected at the retail level, rather than at the producer level, this would impose a substantial administrative burden on SARS, because currently all excise taxes are levied at the producer level.

g. How well-targeted are the proposed interventions?

A sharp instrument is one that achieves the target it sets out to achieve, with minimal negative consequences. The aim of a provincial excise tax or a minimum unit price on alcohol is to reduce abusive drinking, but, presumably, not to cause a large decrease in moderate drinking.

However, it has been noted in the public health and epidemiologic literature that the net health effects of alcohol use, even at modest levels, is negative (Griswold et al., 2018; Wood et al., 2018). If one takes this approach, then any decrease in alcohol is beneficial from a public health perspective. However, given that alcohol is so much a part of South Africa's culture, it would be difficult to find much public support for a policy that frowns upon all kinds of drinking.

On the assumption that one wants to discourage binge and other heavy drinking, the imposition of an excise tax that increases the price of all alcohol products is not very effective. Because the price elasticity of demand for alcohol by moderate drinkers is higher than that of binge and other heavy drinkers, the biggest impact of a price increase will be on the moderate drinkers. This makes a provincial excise tax a blunt instrument.

Consider the option of a minimum unit price for the Western Cape (or the country as a whole). Our data clearly shows that heavy drinkers and, to a much lesser extent, binge drinkers, consume alcohol with a substantially lower unit value, and thus quality, than moderate drinkers. Any visit to a liquor outlet will indicate that there are vast differences in prices, and in the associated qualities. We have been informed that there are a number of manufacturers of ales and other very cheap industrially-produced sugar-fermented alcohol in the Western Cape, whose product is aimed at low-income wage earners, and is nearly always consumed in an abusive way.

Should the Western Cape Government, or the National Government, implement a minimum unit price on alcohol, it would target these very low-price alcohol products. A minimum unit price would not have an impact on higher-priced alcohol.

Our analysis shows that, in terms of the effectiveness of the instrument in targeting the behaviour that one wants to change (i.e. binge and other heavy drinking) a minimum unit price is a much sharper instrument than an excise tax. For all realistic values of a minimum unit price, alcohol consumption by heavy drinkers decreases by a substantially higher percentage than the percentage decrease in consumption by moderate drinkers. For binge drinkers, the percentage decrease in consumption is similar to that of moderate drinkers. A minimum unit price is more effective in reducing the alcohol consumption of binge drinkers than an excise tax.

h. Impact on industry structure

Should the Western Cape Government successfully implement a minimum unit price on alcohol, economic theory suggests that the very-low-price alcohol would quickly disappear from the market. While one may argue that producers of very low-price alcohol could earn some extra money in the short term by charging the legislatively-imposed higher prices, this effect is likely to be short-lived. Economic theory and simple logic indicate that consumers will gravitate to higher quality alcohol if they are faced with a higher price. If the price of very poor quality wine increases from R5 to R15 a bottle, consumers would rather buy a bottle of R15 wine, which, in principle, is of better quality.

A minimum unit price does not generate any revenue for the government, but it also does not result in large additional profits for producers, as one might have thought at the outset. Because of changing consumer patterns, we believe that the bottom end of the market would have to restructure itself. The market for extremely low-price, low-quality alcohol will disappear and be replaced by a market for somewhat better quality, higher priced alcohol. Firms producing very low quality alcohol would have to adjust their product or get out of the market. A minimum unit price is not expected to influence the market at prices above the minimum unit price.

A provincial excise tax is unlikely to change the market structure. The impact of an excise tax on relative prices is likely to be modest, even negligible, with the result that there is no incentive for firms to change their behaviour.

i. Competitive issues

An issue that we have not investigated, but that certainly deserves attention, is whether the setting of a minimum unit price would be allowed by the competition authorities. By definition, a minimum unit price constrains price competition. It is possible that the competition authorities would judge a minimum unit price to be anti-competitive. This would need to be investigated in more detail, should the Western Cape Government wish to pursue this path.

We do not see any competitive issues, should a provincial excise tax be implemented.

j. Home brews, illicit trade and other unrecorded consumption

The alcohol industry will probably argue that a provincial excise tax or a minimum unit price will result in an increase in home brewing, illicit trade, and other unrecorded consumption. At the margin, and for low socioeconomic groups, this is a real possibility. The tobacco industry regularly claims that the high excise taxes result in illicit trade in cigarettes. While there has been a large increase in illicit trade in the past two or three years, probably related to administrative problems at SARS, the industry's claims were without any empirical substance for many years. The message is that claims by the industry about illicit trade and unrecorded consumption need to be independently investigated before they can be taken seriously.

There is no evidence in the National Treasury's data on alcohol excise tax revenue that legal alcohol consumption has decreased at the expense of unrecorded and/or other illicit alcohol. Alcohol tax revenue, at the national level, is generally in line with budget, and in line with what one would expect, given the condition of the economy. The threat of tax evasion by consumers in response to the imposition of a provincial excise does not therefore seem very great.

We do not know how a minimum unit price on alcohol will affect the homebrew market. The analysis in section 6 indicated that some unit values, especially those of heavy drinkers, are extremely low. A minimum unit price will have a profound effect on the average price that these heavy drinkers pay. When faced with a doubling, tripling, or even greater increase in the price, some heavy drinkers would be tempted to switch to cheaper alternatives. Our analysis was too general to investigate this aspect in detail, and we leave this as an important unresolved issue that would need to be investigated in more detail, should the Western Cape Government wish to pursue the route of a minimum unit price.

8. Conclusions

This report was commissioned by the DG Murray Trust to advise the Western Cape Government about the possibility of using price-based instruments to reduce the abusive use of alcohol in the Western Cape, specifically irregular heavy episodic/binge drinking. This report considers two interventions, namely a provincial excise tax and minimum unit price.

Based on the literature review, an econometric analysis using different waves of the National Income Dynamics Study, and two simulation model analyses, we conclude the following:

- Alcohol use in the Western Cape, in terms of per capita alcohol consumption, the prevalence of use, and the intensity of use among drinkers, is broadly similar to that of the Northern Cape, North-West, KwaZulu-Natal, the Free State and Gauteng. The Western Cape does not stand out in comparison to these six provinces. In terms of the composition of the alcohol basket, the Western Cape consumes relatively more wine and relatively less beer and spirits than the rest of the country.
- There is a substantial literature, primarily focused on high-income countries, but increasingly on low- and middle-income countries, that has investigated the demand for alcohol, and specifically the price elasticity of demand for alcohol. The results consistently show that the price elasticity of demand for (generic) alcohol falls in the inelastic range (i.e. between 0 and -1), and is centred around -0.5 for high-income countries and around -0.6 for low- and middle-income countries. This means that a tax-induced increase in the price of alcohol is expected to reduce alcohol consumption, and increase the amount of tax revenue collected.
- The literature clearly indicates that heavy drinkers are less price sensitive than moderate drinkers, making an increase in the excise tax a less effective tool to reduce alcohol use among heavy drinkers. For binge drinkers, the price elasticity estimates fall in a wide range, and do not allow one to make any general comment about average price elasticity for this group of drinkers.
- Using data from the National Income Dynamics Study, we estimate that the price elasticity of demand for alcohol is around -0.22 for irregular heavy episodic/binge drinkers, around -0.15 for other heavy drinkers, and around -0.4 for moderate drinkers. These estimates align closely with price elasticity estimates in the literature.
- Using a simulation model, we find that the imposition of a provincial excise tax on alcohol could be expected to decrease alcohol consumption among all categories of drinkers, with the greatest impact on moderate drinkers, followed by binge drinkers and heavy drinkers (in that order). Depending on the magnitude of the provincial excise tax, the Western Cape

Government would be able to generate substantial revenues from such a tax. There would likely be a small reduction in the excise tax revenue that accrues to the national government, but the increase in VAT revenue (resulting from the higher retail price) would more than compensate for this loss of revenue.

- Using a different simulation model, but based on reported alcohol expenditure and consumption data, we find that a national minimum unit price on alcohol is likely to reduce alcohol consumption among heavy drinkers by a substantially higher percentage than consumption by binge drinkers and moderate drinkers. The impact of a minimum unit price on alcohol consumption by binge and moderate drinkers is broadly similar (for 2008 and 2012), although the analysis shows that it would have had a relatively greater impact on binge drinkers in 2014. If a minimum unit price were to be introduced in the Western Cape, the impact on binge drinkers would be substantially more than on moderate drinkers.
- Since no province in South Africa currently imposes a provincial excise tax on alcohol (or any other excisable good), implementing such a tax in the Western Cape would be unprecedented and is likely to be difficult. As there is freedom of movement across provincial borders, it would be very difficult, in the absence of a Track and Trace system, to levy the tax at source (i.e. on producers), as is typically the case. To levy the excise tax on retailers would require the establishment of a completely new tax collecting infrastructure. Since the Western Cape and the other provinces currently do not have this tax collecting capacity, the onus to collect these provincial taxes might have to be contracted out to the South African Revenue Services.
- A minimum unit price on alcohol is more targeted on reducing binge and heavy drinking, than a provincial excise tax. We presented a conceptual analysis, strongly grounded in empirical work, but the details of how a minimum unit price could be made to work will require additional research.

9. Recommendations

- While a provincial excise tax on alcohol would raise revenue for the Western Cape Government (broadly in proportion to the level of the excise tax), and would reduce alcohol consumption across all categories of drinkers, the institutional and administrative costs of introducing such a tax, and the fact that the excise tax is not specifically targeted on binge drinkers and other heavy drinkers, make the economic case for such a tax weak. Based on these considerations, together with the possibility that the political battle to implement such a tax would divert the Government's attention away from other alcohol harm reducing interventions, and might ultimately be unsuccessful, we recommend that the Western Cape Government does not actively pursue the possibility of implementing a provincial excise tax on alcohol.
- Since alcohol abuse is not limited to the Western Cape but is a national problem, an excise tax levied at the national, rather than at the provincial, level is appropriate. The current alcohol excise tax policy has been in place since 2012, and entails National Treasury targeting a total excise tax burden for the different categories of alcohol. In light of the fiscal shortfalls at the national level and the fact that alcohol excise tax revenue has proven to be a consistent source of revenue, now is an appropriate time to raise the excise tax on alcohol. We recommend that

the Western Cape Government puts pressure on National Treasury to increase the excise tax targets for the various categories of alcohol substantially.

- Although it would not raise revenue for the Western Cape Government, a minimum unit price on alcohol has the potential to reduce alcohol consumption substantially among binge drinkers and, especially, other heavy drinkers. Such a policy would target very cheap, low-quality products. A minimum unit price is a much sharper and more targeted policy instrument than a provincial excise tax on alcohol. We recommend that the Western Cape Government should strongly consider a minimum unit price for the Western Cape, but that it would need much more research about the practicalities of implementing such a policy.

Appendix A: A short description of the data used in the report

In this report we used two datasets to perform the analysis. The first is the National Income Dynamic Study (NIDS), the country's first nationally representative panel study. About 8000 households, which includes about 30 000 members, complete a questionnaire every two years, in which the focus is on a variety of aspects related to quality of life and a host of socioeconomic indicators. The uniqueness of NIDS lies in the fact that the same households are interviewed in each round. To date five waves of data have been collected, in 2008 (wave 1), 2010 (wave 2), 2012 (wave 3), 2014 (wave 4) and 2016 (wave 5). In the individual questionnaire, adult respondents (aged 15+) are asked two alcohol-related questions. The first is about the frequency of drinking (if at all), and the second asks about the number of standard drinks consumed on a typical drinking day. NIDS does not ask respondents which categories of alcohol (e.g. beer, wine and spirits) they consume. In the household section of NIDS (which is typically completed by the household head) the household's expenditure on alcohol in the past 30 days (not broken down by category) is recorded. In this report we typically present analyses based on waves 1, 3 and 4. Unfortunately no alcohol questions were asked in wave 5, and, in order to save space and because of challenges with the fieldwork in wave 2, we do not present the results from wave 2. Wherever possible, we present the weighted data, rather than the unweighted data.

The All Media and Products Survey (AMPS) is a nationally representative commercial survey that focuses on consumption patterns for a large variety of consumer goods. The survey is performed on an annual or sometimes even six-monthly basis. The AMPS is not a panel/longitudinal study, but rather a repeated cross-section. Respondents are asked detailed questions about the type of alcohol that they consume, as well as quantities consumed. Unfortunately, the AMPS data does not allow one to calculate prices or unit values, which makes it impossible to estimate price elasticities of demand. The AMPS was discontinued after 2015. The latest data that was available to us is the 2014 survey.

An issue of considerable importance is the fact that people substantially underreport their consumption of alcohol and their expenditure on alcohol. This is a standard finding for goods that are often regarded as socially undesirable. In fact, in NIDS aggregate consumption of alcohol is underreported by a factor of between 4 and 5, and total expenditure on alcohol by a factor of at least 7. For AMPS there is also a high degree of underreporting, but the scale is not as dramatic as for NIDS. Total alcohol consumption, as derived from the excise tax revenue figures published by the National Treasury on an annual basis, is a much better indicator of actual alcohol consumption in South Africa. The fact that alcohol is often not a regular purchase, like bread, milk or even cigarettes, together with the stigma that is often attached to alcohol use, provides a possible explanation for this phenomenon.

There is not much that can be done about the underreporting of the data, other than interpreting the results with caution. A common assumption in studies that are subject to substantial underreporting of consumption is that the degree of underreporting is consistent across different users. If this is true, analyses that depend on the *relative* changes in consumption and price, like the estimation of price elasticities of demand, will still yield plausible results. Similarly, one can estimate the relative share of alcohol consumption in the Western Cape (and other provinces), even though there may be a high degree of underreporting in the data. However, where the *absolute* magnitude of a variable is important, e.g. how many litres of absolute alcohol are consumed in the Western Cape, then one needs a data source like the National Treasury's Budget Review, rather than NIDS or AMPS. This was the approach that we followed in this report.

Appendix B: Literature Review

This appendix presents a more comprehensive review of the literature summarized in section 3 of the report.

The demand for alcohol has been given a lot of attention in the literature. Given the negative externalities of abusive drinking worldwide, there has been a need for governments to introduce policies aimed at reducing heavy drinking and all the problems associated with it. Increasing prices through excise taxation is said to be the most effective way to reduce the consumption of harmful substances, such as tobacco and alcohol (WHO, 2008). As a result, the objective of most papers on alcohol demand is to understand how consumers react to changes in the price of alcohol. To do this, they estimate price elasticities which allow policy makers to understand clearly how the quantity demanded of alcohol reacts to a percentage change in the price of alcohol. The study of price elasticities has shown that there is heterogeneity in price responses across types of drinkers, gender, and socioeconomic status (Williams et al, 2005; Holmes et al, 2014; Decker and Schwartz, 2000). The existing literature on alcohol demand has also explored factors that affect the efficacy of alcohol excise taxes, such as the availability of substitutes and the advertisement of alcohol (Miller and Droste, 2013; Larivierea et al, 1999). In this review, the first section discusses the estimation strategies that have been used in the literature. The next section reviews findings from meta-studies and explores elasticity estimates from studies done in different countries. This will be followed by sections reviewing the heterogeneity in price response across types of drinkers, gender and socioeconomic status. The last section reviews the findings on the effect of substitutes and complements.

Estimation techniques

Studies have made use of three different types of data to study the demand for alcohol. These include time series, cross-sectional, and panel data. Time-series data is used mainly by older studies published before the 1980s (Huitfeldt and Jorner, 1972; Walsh and Walsh, 1970). More recent studies, on the other hand, have mainly used cross sectional data and panel data (Goryakin et al, 2014; Ramful and Zhao, 2008). While time series data is effective in estimating price elasticities of different alcoholic beverages and the effects of policy, there are some factors that make time series data undesirable to most recent researchers. One of the reasons, which is relevant to this review, is that the aggregate nature of time series data does not allow the researcher to investigate how different socioeconomic groups respond to changes in the price of alcohol (Van Walbeek and Blecher, 2014). As a result, most recent studies prefer to use cross-sectional and panel data.

Several estimation techniques have been used in the literature. The oldest estimation approach is the single equation approach, which is a utility free approach and usually involves the estimation of a single-double log equation (Stone, 1945; Prest 1949). The utility free single-equation approach was superseded by the system-wide utility based models. The most commonly used system-wide approaches include the Rotterdam approach (Barten, 1964; Theil, 1965) and the Almost Ideal Demand System (AIDS) model. Other system wide approaches are a combination of these two.

More recent studies try to incorporate the addictive nature of alcohol in their models (Bray et al, 2009). This is done by including levels of past alcohol consumption in the model. Other recent studies use models that allow for the testing of the rational addiction hypothesis (Becker and Murphy, 1988; Baltagi and Geishecker, 2006), which states that the past, present and future consumptions are

complements. Other estimation techniques are data-specific. Time-series approaches make use of cointegration techniques (Yu and Chen, 1998). The most commonly used cross-sectional and panel data approaches include Ordinary Least Squares (OLS), Seemingly Unrelated Regression (SUR) estimation, Full Information Maximum Likelihood (FIML), Random Effects (RE) models, Fixed Effects (FE), and the Two Stage Least Squares (2SLS) approach.

Findings from Meta-studies

There is a wide range of alcohol price elasticity estimates from various studies on alcohol demand. While all estimates carry a negative sign, as expected, they vary greatly in terms of magnitude, making it hard to make sense of them. This is where meta-studies are useful. Meta-studies extract elasticity estimates from various studies and use meta-regressions to draw useful conclusions from the estimates available. The variance in the estimates obtained in the literature is attributed to differences in study characteristics. These characteristics include data type, data frequency, methodology, year of publication and so on. In meta-regressions, the elasticity estimates are regressed on these study characteristics to extract useful patterns.

Three meta-studies (Gallet, 2007; Fogarty, 2010; Wagenaar *et al.*, 2009) have analyzed the elasticities in the existing literature of the demand for alcohol. However, it is worth noting that these meta-studies primarily focus on High Income Countries (HICs). Gallet (2007) conducted a meta-analysis based on 132 studies. This was done by regressing estimated price, income and advertising elasticities of alcohol on variables accounting for study characteristics. The findings show that alcohol elasticities are particularly sensitive to demand specifications, data issues, and various estimation methods. Regarding the elasticities of alcoholic beverages, the study found that, compared to other alcoholic beverages, beer tends to be more inelastic. Similarly, Wagenaar et al (2009) reviewed 112 studies and found the beer is a price inelastic beverage. The elasticities are -0.46 for beer, -0.69 for wine and -0.80 for spirits. Fogarty (2010) found that the demand for alcohol has become less inelastic since the 1950s and that the income elasticity has been falling since the mid-1960s.

The idea of demand for alcohol becoming more or less price inelastic over time has been explored by some researchers (e.g., Mazzochi, 2006). The change in the magnitude of elasticity over time is primarily the result of changes in the drinking culture, which are reflected in consumer preferences (WHO, 2017). A stronger preference for alcohol, relative to other intoxicants such as tobacco, has the potential to reduce the magnitude of price elasticities of alcohol demand over time. A study by Mazzocchi (2006) examined alcohol and tobacco trends in the United Kingdom and found that the short-run price elasticity of alcohol decreased from -0.76 in 1986 to -0.42 in 2003. The study explains that the decline in the price elasticity resulted from an increase in the preference for alcohol over tobacco.

Similarly, elasticities of alcoholic beverages may change from time to time because of changes in drinking culture or preferences. Fogarty (2006) finds that there is a negative relationship between alcohol elasticity and market share. Therefore, a higher market share is associated with a low price elasticity, and a lower market share is associated with higher elasticities. Changes in the popularity or dominance of alcoholic beverages can therefore affect their demand elasticities. The study by Babor et al. (2010) shows that, in Sweden, spirits were dominant (inelastic) during the first half of the 20th century, but beer and spirit dominated the market from 1968 to 1986, and wine become popular from 1984 to 2004.

To the best of our knowledge, there is only one meta-study which focuses primarily on Low- and Middle Income Countries (LMICs). Sornpaisar et al. (2013) reviewed 12 studies that examine the relationship between alcohol price and alcohol consumption in LMICs. While the elasticities obtained do not differ much from those of HICs, they indicate that LMICs are slightly more price responsive than HICs. The estimated price elasticity for overall alcohol consumption was found to be -0.64, which is slightly higher than the -0.51 estimated for HICs (Wagenaar *et al*., 2009). For the price elasticities of different beverage types, Sornpaisar *et al.* (2013) estimated an elasticity of -0.5 for beer and -0.78 for other alcoholic beverages (including wine and spirits).

Although research on alcohol demand has been conducted in several countries, the focus has been on HICs. The United Kingdom (UK), and the United States of America (USA), in particular, have received the most attention in the literature. A couple of papers are based in low- and middle-income countries, but these are mostly Asian countries (Goryakin et al, 2014; Chelwa et al, 2018; Veh et al, 2013). Table B1 illustrates different price elasticity estimates obtained from studies conducted in different countries. Some patterns found in meta-studies can clearly be seen. Table B1 shows that beer is the most inelastic alcoholic beverage, across all studies, and that alcohol demand is becoming less inelastic with time.

Table B 1: Price elasticity estimates from different countries

Country, Period	Beer	Wine	Spirits	
USA, 1949-1982	-0.09	-0.22	-0.10	Clements and Selvanathan (1988)
Canada, 1953-1985	-0.28	-0.58	-0.30	Quek (1988)
UK, 1955-1985	-0.13	-0.40	-0.13	Selvanathan (1991)
Australia, 1955-1988	-0.15	-0.60	-0.61	Selvanathan (1991)
Finland, 1969-1986	-0.60	-1.30	-1.00	Salo (1990)
Sweden, 1995-2004	-0.92	-0.24	-1.29	Asplund et al (2007)
Australia, 1999-2001	-0.95	-1.85	-0.73	Ramful and Zhao (2008)
Czech Republic, 2002-2007	-0.97	-1.09	-1.21	Janda et al(2010)
Taiwan, 1974-2009	-0.82	-0.96	-0.59	Veh et al (2013)
Vietnam, 2010-2014	-0.28	-0.32		Chelwa et al (2018)

While literature on alcohol demand is scarce for most African countries, South Africa has been an exception. The study by Chelwa and Van Walbeek (2014) estimated a total price elasticity of -0.52, which is in line with the estimates found in the international literature. National Treasury and the Bureau for Economic Research estimated elasticities for different alcoholic beverages. The results obtained from the two studies are summarized in the tables B2 and B3 below:

Table B 2: Elasticity for Alcoholic Beverages, Bureau of Economic Research

Category	Income elasticity	Price elasticity

Malt beer	0.45	-0.70
Natural Wine	0.50	-1.00
Standard priced wine	-0.80	-1.00
Flavoured alcoholic drinks (FADs/ AFBs)	2.00	-1.25
Ready to drink beverages (RTD/ Spirit coolers)	2.20	-2.50
Spirits	0.65	0.90
Total Liquor	0.65	0.75

Source: National Treasury, 2014b

Table B 3: Elasticity estimates of alcoholic beverages from the National Treasury

Category	Income Elasticity	Price Elasticity
Malt beer	0.46	-0.47
Natural wine	0.76	-1.08
Spirits	0.95	-0.75
Commercial Sorghum beer	-1.14	0.67

Source: National Treasury, 2014b

Because of differences in product classification and the estimation techniques used, the results of the two studies are not directly comparable. The differences in the magnitude of the estimated results stem from the fact that the BER estimated long-run elasticities whereas the National Treasury estimated short-run elasticities. Generally, long-run elasticities tend to be larger than short-term elasticities (Becker and Murphy, 1988). The results obtained from these studies suggest that natural wine tends to be both more income elastic and more price elastic than malt beer. Furthermore, flavored alcoholic drinks and ready-to-drink beverages are associated with greater price and income elasticities, and the price elasticity of spirits is greater than that for malt beer, but relatively less than that for natural wine.

Types of drinker

Consumers of alcohol differ in terms of the frequency and intensity of their drinking. These differences affect the way consumers respond to changes in alcohol prices. In the literature, three types of drinkers are identified: moderate drinkers, heavy drinkers, and binge-drinkers (Saffer et al, 2012; Kenkel, 1993; Nelson, 2008). Two main definitions have been used for binge-drinking. The first is the five/four (5/4) drinks definition, which considers binge-drinking to occur if five or more drinks (four or more for females) are consumed on one drinking occasion. Despite its wide spread use, this definition has been criticised as an insufficient measure because it does not take into account the duration of the drinking episode (Fillmore and Jude, 2012). In 2004, the National Institute on Alcohol Abuse (NIAAA) defined binge-drinking as a pattern of drinking alcohol that brings the level of alcohol in the blood to 0.08 gram-per cent or above. For the typical adult, this pattern corresponds to consuming 5 or more drinks (male), or 4 or more drinks (female), in about 2 hours (NIAAA, 2004).

While there are many studies on binge drinking, studies examining the price responsiveness of binge drinkers are scarce. There seems to be no consensus on the price responsiveness of binge drinkers. Three of the papers reviewed by Elder *et al.* (2010) show that price elasticity estimates for binge drinkers range between -0.29 and -1.29. Without estimating price elasticities, Keng and Huffman (2010) examined the relationship between alcohol price and binge-drinking among individuals under the age of 40. The econometric results of the study show that the overall price of alcohol has a statistically significant effect on binge-drinking variables, implying that the decision to binge-drink is responsive to price. However, econometric results from other studies provide evidence that alcohol prices or taxes have no significant impact on binge-drinking (Nelson, 2008; Rhoads, 2010). While there is no consensus on the price responsiveness of binge-drinkers, the case is different for moderate and heavy drinkers.

There are many ways of defining these types of drinkers. The standard definition, used by many papers, is that moderate drinking is the consumption of four or fewer drinks in a day, whereas heavy drinking is defined as the consumption of five or more drinks in a day. However, some studies look at three categories: light, moderate, and heavy drinking (Manning *et al.*, 1995; An and Sturm, 2011). Some of these studies base their definition on the number of drinks per month as opposed to the number of drinks per day (An and Sturm, 2011).

Heavy drinkers are usually found be more price inelastic than light/moderate drinkers. Although the study by Manning *et al.* (1995) failed to reject the hypothesis that heavy drinkers are perfectly price inelastic, most studies find them responsive, though their response is weaker than that of moderate drinkers. Evidence provided by Williams *et al.* (2005) shows that both moderate and heavy drinkers respond to changes in the price of alcohol by reducing their consumption. This finding is reinforced by several other studies that have estimated price elasticities (Harris *et al.*, 2006; Aepli, 2014; Ayyagari *et al*., 2013). For instance, the price elasticities estimated by Meier *et al*. (2010) are -0.47 for moderate drinkers and -0.21 for heavy drinkers. In the case of South Africa, Chelwa and Van Walbeek (2014) estimated an elasticity of -0.56 for light drinkers and -0.28 for heavy drinkers. The finding that moderate drinkers are more responsive than problem drinkers presents a challenge to the implementation of price-based policies to reduce alcohol consumption. Such policies will have a greater effect on the light/moderate drinkers and would have a minimal effect on the problem drinkers (An and Sturm, 2011).

Heavy drinkers differ within the category in terms of how informed they are on the harmful effects of heavy drinking . A study by Kenkel (1993) investigated the effect of information the price response of heavy drinkers. The paper identified three types of drinkers: moderate drinkers, informed heavy drinkers and uninformed heavy drinkers. The information variable in the study reflected the levels of knowledge heavy drinkers had on the health costs of heavy drinking. As in most studies, moderate drinkers were found to be price sensitive both in terms of frequency and quantity. In the case of heavy drinkers, the paper found that heavy drinkers with more complete information are more price sensitive than uniformed heavy drinkers. This study, therefore, highlighted the importance of information for the effectiveness of a price based policy.

The availability of different types of alcoholic beverages could mean that different types of drinkers respond differently to the prices of different alcoholic beverages. Aepli (2014) is one of the few studies that have explored this possibility. The paper uses household data to investigate the price response

of drinkers (light, moderate and heavy) by beverage type. The findings show that heavy-drinking households are much less price responsive, with respect to wine and beer, than light and moderate drinkers.

Gender and Age

There are also differences in price responses among different age groups. Most studies on addictive goods find that younger individuals tend to be more price sensitive because they have not been exposed to the good long enough to be addicted (Lewit *et al*., 1981). The same applies to the consumption of alcohol. A study by Kenkel (1993) estimated price elasticities for young adults. The estimates are -0.95 for young males and -3.54 for young females, which are higher than those for the general population, -0.71 for males and -1.14 for females. This finding is supported by other studies (Xu and Chaloupka, 2011) which provide evidence that young adults are more price sensitive than the general population. Gallet (2007), on the other hand, found that the youths are less responsive than the adult population. This is an odd result, given the findings from other studies on alcohol and addictive goods. The explanation for the finding was that young people are more likely to drink beer, which is less price sensitive, and therefore they are also less price sensitive.

Studies have also explored gender differences in alcohol demand. Although there is usually the problem of under reporting of alcohol consumption by both males and female, the data has been able to reveal that alcohol prevalence is higher among males than among females. The data also indicates that males are more likely to be heavy drinkers than females. A study by Nelson (2014) is one of the recent papers that has explored the gender and age differences in alcohol demand. The findings of the study suggest that young adults, regardless of gender, are not easily dissuaded from heavy drinking by higher prices. The paper provides evidence to support the hypothesis that drinking by men is less elastic than that of women, and the evidence suggests that both older and younger heavy-drinking men have highly inelastic demands. A consensus in the literature is that females are more price sensitive that males. Table B4 shows price elasticities estimated for males and females by different studies.

Table B 4: Price elasticity by Gender

	Male	Female	
Russia	-0,16	-0,23	Andrienko and Nemtsov (2005)
USA	-0,21	-0,31	Decker and Schwartz (2000)
USA	-0,83	-1,44	Kenkel (1993)
China	-0,03	-0,11	Shi (2011)

Socioeconomic status

Studies have also investigated the heterogeneity in alcohol demand for different socioeconomic groups. It has been noted that although disadvantaged groups tend to underreport alcohol consumption, they experience the most severe health outcomes from alcohol consumption compared to those with a high socioeconomic status (Jefferis *et al*., 2007; Schmidt *et al*., 2009). Thus, alcohol policy to reduce consumption could benefit disadvantaged consumers the most. The study by Cheah (2015) used logit models to analyze the factors affecting the likelihood of heavy and light alcohol drinking. The findings suggest that the likelihood of heavy alcohol drinking is positively associated with lower-income earners, the less educated, rural dwellers, and the unemployed. On the other hand, the likelihood of light drinking was found to be positively associated with higher-income earners, the well-educated, urban dwellers, and the employed. There is, therefore, a need for a price-based intervention that could help reduce the likelihood of heavy drinking for disadvantaged consumers.

The main variables used to measure socioeconomic status include level of education, geography (rural/ urban), income level, and employment status. The common finding is that individuals with a low socioeconomic status are usually more responsive to price changes than those with a high socioeconomic status. A US based study by Ayyagari *et al*. (2013) found two latent groups; a price-responsive group and a price-unresponsive group. The study showed that the group with greater responsiveness was disadvantaged in multiple domains, such as health, financial resources, education, and perhaps planning ability.

Jiang *et al.* (2016) used income to measure socioeconomic status. Their paper compares the price responsiveness of lower-income and higher-income groups. The results of the study show that lower-income groups are more responsive to prices than middle- and higher-income groups. A similar finding was obtained by Holmes *et a.l* (2014) who investigated how different income and socioeconomic groups respond to minimum unit pricing for alcohol. Lower-income individuals were found to be more price sensitive than those belonging to the high-income group. Similarly, by using household expenditure as a measure of socioeconomic status, Chelwa and Van Walbeek (2014) concluded that disadvantaged households are more price sensitive. The study estimated the elasticities of the top 50% and bottom 50% of households by total household expenditure. The price elasticity of demand for the top 50% was found to be -0.54 while that of that the bottom 50% was found to be -0.86.

Using level of income and employment status to proxy socioeconomic status, Arnoult and Tiffin (2010) estimated price elasticities by socioeconomic group. The results show that low-income individuals are more responsive (-0.83) than high-income individuals (-0.81) to price changes. In terms of employment status, students were found to be the most responsive (-0.94) and the unemployed were found to be the least responsive (-0.82).

Geography is another variable that has been used to proxy socioeconomic status. Kumar (2017) estimated the price elasticities of rural and urban drinkers. Price elasticity was found to be higher for rural drinkers, except in the case of the demand for spirits. The elasticities for beer and spirits were not statistically significant in urban areas, while country liquor responds significantly in urban areas. Rural drinkers are most responsive to price and the magnitude of response is highest for country liquor, followed by beer.

Kumar (2017) also used education as a proxy for socioeconomic status. The differences in elasticiy estimates for country liquor were found to be insignificant at different educational levels. The demand for beer is more elastic for drinkers with less than a university-level education, while spirit drinkers with at least a university degree are very responsive to changes in the price of spirits.

Substitution effects

Consumers have a tendency to substitute one good for another to avoid price increases. The substitution effect, therefore, has a profound impact on policy effectiveness. Alcohol has three main categories: beer, wine and spirits. Each of these categories has multiple sub categories. One cannot look at the demand for one beverage in isolation. The effect of an increase in the price of beer can have an impact on the quantity demanded of spirits and wine. Similarly, an increase in the price of wine can influence the quantity demanded of beer and spirits. To study the price effects of one beverage on the consumption of other beverages, cross-price elasticities are estimated.

A positive elasticity between two alcoholic beverages implies that the beverages are substitutes. Thus, an increase in the price of one beverages results in an increase in the demand for the other beverage. The opposite is true when the coefficient turns out to be negative. In such a situation, the beverages are said to be complements. In that case, an increase in the price of one beverage leads a decrease in the consumption of the other. Although the magnitudes and signs differ from study to study, there is evidence that consumers do switch between beverages (Bielinska-Kwapisz and Mielecka-Kubien, 2011; Decker and Schwartz, 2000).

Bielinska-Kwapisz and Mielecka-Kubien (2011) used Polish data to estimate cross-price elasticities between beer, wine and spirits. The study concluded that beer and wine are complements, spirits and wine are substitutes, and no significant relationship was found between beer and spirits. These findings differ from the results obtained by studies conducted in other countries. Duffy (2001) obtained estimates for the United Kingdom and found that all three beverages were substitutes for each other. However, differences in the magnitudes of the coefficients revealed that wine and spirits are strong substitutes (with an estimate of 0.65), beer and spirits are weak substitutes (with an estimate of 0.01), and beer and wine are also weak substitutes (with an estimate of 0.11).

Consumers can also substitute between subcategories of the same alcoholic beverage. Different brands differ in quality and this results in differential pricing between brands. Using Swedish data, Gruenewald et al. (2006) showed that in response to increased alcohol prices, consumers substitute between beverages and across beverages. It was observed that the decrease in alcohol sales, resulting from price increases, was mitigated by the substitution between quality classes. These findings suggest that the effectiveness of a policy also depends on the range of prices across brands. Hobday et al. (2016) used Australian data, and concluded that heavy drinkers are more likely to substitute cheaper brands or cheaper beverage types in the face of high alcohol prices.

In certain cases alcohol consumers may substitute other, more harmful, intoxicants for alcohol. Heavy drinkers are likely to complement their beer consumption with other intoxicants and are more likely to substitute other substances for alcohol (Moore, 2010). Decker & Schwartz (2000) evaluated the relationship between alcohol and cigarettes in an attempt to establish if the two are either substitutes or complements. The findings show that an increase in the price of alcohol leads to a reduction in the consumption of both alcohol and cigarettes, suggesting that they are complementary goods. However,

an increase in the price of cigarettes reduced the consumption of cigarettes but increased the consumption of alcohol, suggesting that alcohol is a substitute for cigarettes.

Advertising

Studies on the effect of advertising have provided little support for the view that alcohol advertising has an effect on consumption levels. Studies that have estimated advertising elasticities have found a positive elasticities but the magnitudes are very small. The demand for spirits has been found to be the most responsive to advertising. While the consensus is that that advertising does not have a significant effect on overall alcohol consumption, there is evidence that advertising has an impact on market shares.

The meta-study by Gallet (2007) found that the estimated advertising elasticities tend to be positive in the existing literature. The results from the meta-regression show that the demand for spirits is more responsive to advertising that that of the other beverages. Given the difference in study characteristics, the magnitude of these elasticities differ from study to study. The observation is that advertising elasticities are "smaller for more recent studies, with a double-log or semi log specification, which includes other alcohol prices, measures quantity in ethanol-equivalent units, and is estimated using Genaralized Least Squares. Yet the advertising elasticity tends to be larger when demand is estimated with country-level data (using 2SLS or 3SLS) and corrected for serial correlation" (Gallet, 2007).

Duffy (1987) tested the assertion that advertising affects the composition of demand among industry or product groups. To do this, the paper investigated the effect of advertising of the three main categories of alcohol: beer, wine and spirits. The effect of advertising was found to be too weak and gave little support to the view that advertising can influence consumers to change their budget allocation on alcoholic beverages. The estimated own-advertising elasticities are 0.05 for beer, 0.11 for spirits and 0.15 for wine.

Studies have found that advertising is more effective in encouraging brand loyalty and increasing market share. Larivierea et al.(1999) concluded "that advertising has very subtle effects on expenditures on alcoholic beverages. Thus, advertising is not effective in enlarging markets and this suggests that firms use advertising to compete in zero-sum market share games" (Larivierea *et al.*, 1999). Similarly, Nelson (1999) found that advertising mainly affects brand shares and not consumption. The paper concluded in the first place, that alcohol advertising does not have a statistically significant effect on total alcohol consumption and, secondly, that broadcast advertising is not a significant factor leading to increased consumption of alcohol and does not appear to differ from print advertising despite different rates of use. Broadcast advertising of beer does not have a statistically significant effect on the own-demand for beer, suggesting that broadcast advertising affects brand share and not beverage demand.

In contrast to the findings by Nelson (1999), a more recent study by Saffer *et al* .(2012) found that advertising can be effective in increasing the consumption of alcohol. Advertising is more effective in increasing consumption at high past-consumption levels, but less effective at low past-consumption levels. This suggests that advertising has more impact on heavy drinkers than moderate or light drinkers.

To reduce the consumption of alcohol, a ban on advertisement is another intervention that can be used by government. However, the literature has not shown much support for the efficacy of this type of intervention. Nelson (2003) noted that bans on alcohol advertising do not reduce total alcohol consumption. The paper indicates that this could be a result of the substitution effect. Alcohol companies usually have alternative forms of promoting alcoholic beverages to the public, such as the use of surrogate advertising (Ahuja, 2015). Other alternatives to advertisement bans, such as alcohol counter-advertisement (Agostinelli and Grube, 2002), have been suggested in the literature.

Appendix C: Technical details on the estimation of price elasticities of Demand

In this appendix, we discuss in greater detail the method used to derive the price elasticities of demand presented in Section 4 of the report. The discussion of the method borrows heavily from Chelwa and Van Walbeek (2014) and Chelwa (2015).

This report uses the method proposed by Deaton (1988) and extended in Deaton (1989, 1990 and 1997) to estimate price elasticities of demand for alcohol in South Africa. The method exploits the fact that prices of most goods in Low- and Middle-Income Countries (LMICs) vary across geographical space (and are fixed within clusters) owing to the presence of significant transportation costs and the fact that markets are usually small and isolated. This last point makes it difficult to take advantage of price disparities between markets. Since most household expenditure surveys in LMICs do not collect data on prices, Deaton proposes the use of what he calls "unit values" as a proxy. In the case of alcohol, unit values, υ, are defined as the ratio of total household expenditure on alcohol, to quantity of alcohol purchased or

$$\upsilon_{ic} = \frac{x_{ic}}{q_{ic}} \qquad \text{(C1)}$$

where υ_{ic}, x_{ic} and q_{ic} are respectively the unit value, expenditure and quantity of alcohol in household i located in cluster c. Unit values, however, are not the same thing as prices. For one thing, unit values hide a great degree of quality heterogeneity whereas the classic treatment of demand concerns itself with homogeneous goods. With quality heterogeneity, households may respond to a price increase by shifting to a lower "quality" alcohol with a small decline in quantity. Deaton refers to this as "quality shading". Under classic demand theory, the only outcome of a rise in prices is a reduction in demand. With quality shading, the price elasticity of demand will be overestimated[2]. Second, unit values are not the same as prices because of measurement error. Households are unlikely to recall correctly the amount of money spent on alcohol and/or the quantity consumed. In some cases, the survey enumerator might incorrectly capture this information. In such a case, the ratio of expenditure to quantity would result in a wrong price even if alcohol were a homogeneous product (i.e. alcohol was not susceptible to quality shading). The presence of measurement error will bias the estimate of the price elasticity of demand[3].

By defining quality as "the value of a bundle of goods at fixed reference prices" (Deaton, 1997, p. 297) and assuming that preferences are separable over bundles of goods (Deaton and Muellbauer, 1980), Deaton derives formulae that can be used to correct the final price elasticity estimates for quality

[2] Recall that the formula for the price elasticity of demand, ε, is given as:

$$\varepsilon = \frac{\Delta q/q}{\Delta p/p}$$

where Δq and Δp are the changes in price and quantity respectively. With quality shading, the price does not change in full and so the reported change in price (which is really the reported change in unit value) is smaller (in absolute size) than it would be if we had actual price data. Since the denominator in the price elasticity formula is smaller than it would otherwise be, the estimated price elasticity is bigger in absolute size.

[3] The direction of the bias will depend on the nature of the correlation, if any, between measurement error in expenditure and measurement error in quantity (see Deaton, 1997, p. 292 – 293).

shading. Concerning measurement error, recall that prices are assumed to be fixed within clusters. In other words, all households within a cluster should report prices that converge on the "cluster price" (which could either be the average cluster price or the median cluster price). Any household reporting a price that is different from the cluster price should be the result of measurement error. Quantifying these deviations from the cluster price allows us to correct our price elasticity estimates for measurement error (see below).

Deaton's method proceeds in a series of steps. The first step involves checking whether prices (unit values in this case) vary across geographical space. This can be done in one of two ways: (1) using Analysis of Variance (ANOVA) to divide the total variation in unit values into "within cluster variation" and "between cluster variation" or (2) running a regression of unit values on cluster dummies. A large F statistic in either case leads to the conclusion that unit values vary across space. In the second step, one estimates "within cluster" regressions of the form:

$$lnv_{ic} = \lambda + \beta lnx_{ic} + \boldsymbol{\gamma Z_{ic}} + \psi ln\pi_c + e_{ic} \qquad \text{(C2) and}$$

$$w_{ic} = \alpha + \varepsilon lnx_{ic} + \boldsymbol{\delta Z_{ic}} + \theta ln\pi_c + (FE_c + u_{ic}) \qquad \text{(C3)}$$

w_{ic} represents the share of alcohol expenditure in total household expenditure for household i in cluster c and lnv_{ic} is the log of the unit value, derived according to equation C1 for household i in cluster c. lnx_{ic} is the log of total household expenditure over the relevant reference period. $\boldsymbol{Z_{ic}}$ is a vector of household specific characteristics including household size, household gender composition, gender of the household head, proportion of adults in the household, and years of schooling of the household head. Other variables in $\boldsymbol{Z_{ic}}$ are the racial category of the household head, an indicator variable for whether the head is married or not, and a measure of the geographical location of the household. FE_c is a cluster fixed effect. u_{ic} and e_{ic} are the standard regression error terms. $ln\pi_c$ represents the unobserved prices and consequently, equations C2 and C3 are estimated without them. The coefficients on the price terms can, however, be recovered (see below).

Equation C2, referred to as the "unit value" equation, allows us to check for the presence of quality effects in the unit value data. A positive and statistically significant relationship between household expenditure and unit values, after accounting for household characteristics, would suggest the presence of quality effects. That is, richer households report higher unit values primarily because they are buying alcohol of a higher quality. Knowing the pattern of the quality effects (i.e. the magnitude of β) allows us to correct our final price elasticity estimates for quality shading. Equation C3, on the other hand, is a standard demand equation where the alcohol share is expressed as a function of household income (proxied by household expenditure), household characteristics, and prices. Because of the assumption that prices are fixed within clusters and the fact that we do not have price data, prices are proxied by cluster fixed effects (FE_c). Further, the cluster fixed effects also allow us to hold constant cluster-level tastes and preferences. Similar tastes and preferences are to be expected for narrowly-constructed clusters such as villages. Unlike the demand equation, the unit value equation C2 does not contain cluster-level fixed effects even though unit values are related to price. Adding a cluster-level fixed effect to equation C2 "would break the link between prices and unit values, would prevent [unit values] giving any useful information about [prices], and would thus remove any possibility of identification" (Deaton, 1997, p.295). Equations C2 and C3 also contain useful information about measurement error at the household level. The magnitude of the errors are captured by e_{ic} and u_{ic}, the regression error terms. The relationship between the two errors (as

captured by, for example, the covariance) is useful in correcting the final price elasticity estimates for measurement error (see more below).

The third step involves stripping the household-level demand and unit values of the effects of household expenditure and household characteristics and then averaging across clusters. This step requires the following equations:

$$\widehat{y_c^1} = \frac{1}{n_c}\sum_{i=1}^{n_c}(lnv_{ic} - \hat{\beta} lnx_{ic} - \widehat{\boldsymbol{\gamma}}\boldsymbol{Z_{ic}}) \qquad \text{(C4) and}$$

$$\widehat{y_c^2} = \frac{1}{n_c}\sum_{i=1}^{n_c}(w_{ic} - \hat{\varepsilon} lnx_{ic} - \widehat{\boldsymbol{\delta}}\boldsymbol{Z_{ic}}) \qquad \text{(C5),}$$

where n_c is the number of households in cluster c. $\widehat{y_c^1}$ and $\widehat{y_c^2}$ are the estimates of, respectively, cluster average unit value and cluster average demand after removing the effects of household expenditure and household characteristics (notice that $\widehat{y_c^1}$ and $\widehat{y_c^2}$ do not have the i subscript because they represent cluster averages). Recall that our identifying assumption is that prices vary at the cluster level (i.e. between clusters and not within clusters). Given this identifying assumption, price elasticities of demand can only be obtained by seeing how cluster-level demand responds to changes in cluster-level prices. This leads to the fourth step which involves regressing cluster-level demand, $\widehat{y_c^2}$, on cluster-level unit values, $\widehat{y_c^1}$. The coefficient on $\widehat{y_c^1}$ in such a regression can alternatively be obtained by dividing the covariance between $\widehat{y_c^2}$ and $\widehat{y_c^1}$ by the variance of $\widehat{y_c^1}$. That is $\hat{\phi}$, the estimate of the coefficient on y_c^1, is obtained by

$$\hat{\phi} = \frac{Cov\left(\widehat{y_c^2}, \widehat{y_c^1}\right) - \frac{\widehat{\sigma^{12}}}{n_{size}}}{Var\left(\widehat{y_c^1}\right) - \frac{\widehat{\sigma^{11}}}{n_{size}}} \qquad \text{(C6),}$$

where n_{size} is the average cluster size (households) in the sample; $\widehat{\sigma^{12}}$ is the estimate of the covariance of the errors in equations C2 and C3; and $\widehat{\sigma^{11}}$ is the variance of the errors in equation C2. Equation C6 is a standard errors-in-variables regression where the covariance and variance of errors are used to correct for measurement error. Notice that the correction factors for measurement error become small as the average cluster size becomes large (i.e. as $n_{size} \to \infty$). So the consistency properties of Deaton's method rely on the number of clusters as opposed to the number of households.

The fifth and final step in Deaton's method applies quality correction formulae to obtain the estimate of the price elasticity of demand, $\widehat{\varepsilon_P}$, as follows:

$$\widehat{\varepsilon_P} = \left(\frac{\hat{\theta}}{\bar{w}}\right) - \hat{\psi} \qquad \text{(C7),}$$

where $\bar{w}$ is the average share of total household expenditure dedicated to alcohol in the sample. $\hat{\psi}$ and $\hat{\theta}$, the estimates of the coefficients on the unobserved price terms in equations C2 and C3 respectively, are recovered as follows:

$$\hat{\psi} = 1 - \frac{\hat{\beta}(\bar{w} - \hat{\theta})}{\hat{\varepsilon} + \bar{w}} \qquad \text{(C8) and}$$

$$\hat{\theta} = \frac{\hat{\phi}}{1+(\overline{w}-\hat{\phi})\hat{\zeta}} \quad \text{(C9) with}$$

$$\hat{\zeta} = \frac{\hat{\beta}}{\hat{\varepsilon}+\overline{w}(1-\hat{\beta})} \quad \text{(C10).}$$

$\hat{\beta}$ is the estimate of the coefficient on total household expenditure in equation C2, the within-cluster unit value equation, and $\hat{\varepsilon}$ is the estimate of the coefficient on total household expenditure in equation C3, the within-cluster demand equation. $\hat{\phi}$ is the errors-in-variables estimate of the coefficient of a regression of cluster-level demand on cluster-level unit value.

Table C 1: Descriptive Statistics from the Sample[4]

Variable	Wave 1	Wave 3	Wave 4
Percentage of households with positive alcohol expenditure	20.16%	24.30%	24.66%
Average alcohol share in total household expenditure	14.46%	15.31%	17.48%
Median unit value per standard drink in nominal Rands[5]	4.76	9.09	9.67
Average annual quantity of standard drinks	180.52	191.09	201.81
Average annual household expenditure on alcohol in nominal Rands	1918.77	2817.58	3399.20
Average annual household expenditure in nominal Rands	25488.43	31224.02	52054.04
Average household size	4.27	4.65	4.67
Average proportion of adults in the household	64.79%	62.80%	61.27%
Average proportion of males in the household	42.65%	41.47%	42.17%
Average proportion of household heads who are male	55.40%	38.34%	44.00%
Average proportion of household heads married/partners	48.68%	41.26%	37.84%
Proportion of adult heads who are:			
Black/African	72.29%	80.65%	81.06%
Coloured	13.47%	13.23%	12.64%
Indian	1.43%	1.07%	0.80%
White	7.51%	3.91%	3.08%
Missing racial categorization	5.30%	1.15%	2.42%
Proportion of household heads with:			
No Schooling	20.11%	15.54%	13.27%
Primary Incomplete	20.02%	17.46%	16.32%
Primary Complete	7.33%	7.41%	6.69%
Secondary Incomplete	26.33%	33.76%	35.61%
Matric	17.61%	21.58%	22.23%
Tertiary Education	2.66%	2.91%	2.86%
Missing Education Information	5.93%	1.33%	2.82%
Proportion of Households in:			
Rural Formal	37.16%	38.70%	37.92%
Tribal Authority Areas	52.91%	54.89%	56.00%
Urban (Formal and Informal)	9.94%	6.40%	6.08%
Number of Households	7296	8030	9625
Number of Clusters	400	396	398

Source: National Income Dynamics Study

[4] All the statistics presented in this table are unweighted and merely give a flavor of the characteristics of the sample used to derive the elasticities. All monetary amounts are presented in nominal rands.

[5] Note that this median is unweighted and is presented in nominal rands. It is different from the weighted median used in the simulation exercise in the report and discussed in detail in Appendix E.

Descriptive statistics from the three waves used in the analysis are contained in Table C1. As stated earlier, Deaton's method requires that prices vary across clusters. Table C2 below tests this requirement across the three waves using Analysis of Variance (ANOVA). The null hypothesis is that prices do not vary across clusters. The p-values in the table show that the hypothesis is rejected in all three samples. These p-values are equivalent to the ones we would obtain had we tested the joint significance of cluster dummies in a regression of unit values on cluster effects.

Table C 2: Spatial Variation Hypothesis

Wave 1				**Wave 3**				**Wave 4**			
F statistic	p value	R-squared	n	F statistic	p value	R-squared	N	F statistic	p value	R-squared	n
1.76	0.00	0.41	1249	1.55	0.00	0.30	1674	1.46	0.00	0.25	2057

Notes: The F statistic and the p-value are associated with the null hypothesis of no spatial variation in unit values. The hypothesis is rejected in all 3 samples.

The next step in Deaton's method involves running the unit value and budget share equations (equations C2 and C3). The results of this exercise for all three waves, including sub-samples of each wave, are contained in tables C3 to C8. Tables C3 to C5 show the results of the unit values regressions (equation C2). In those tables we see that household expenditure has a positive and statistically significant effect on reported unit values after accounting for all other household characteristics. This result holds across all three waves and their respective sub-samples. The implication of this is that there are quality effects in the data, with better-off households reporting larger unit values. This means that the final elasticity estimates have to be corrected for quality shading using the formulae in equations C7 to C10. Tables C6 to C8 show the results of running the budget share regressions (equation C3) on the three waves and their respective sub-samples. The results of those regressions show that the cigarette budget share declines with an increase in household expenditure after accounting for other household characteristics.

After running the main regressions and obtaining the necessary coefficients, we can apply the formulae in equations C4 to C10 to obtain the price elasticities of demand, presented in Table 6 in the main report. Since the formulae in equations C7, C8, C9 and C10 are not Stata commands, the standard errors have to be obtained via the method of the bootstrap. This is done by running the cluster-level regressions 1000 times and in each instance using the formulae in equations C7, C8, C9 and C10 to compute the price elasticity.

A point to note from Table 4 in the report is that elasticities of sub-samples do not often straddle the full sample elasticity. This is primarily because sub-sample elasticities are, by definition, estimated on different samples than the full sample. And given that the formulae presented above rely on sample specific moments (such as the average alcohol share) implies that the elasticities so-derived, especially for sub-samples, may not necessarily straddle the full sample elasticity. Guindon et al. (2011) also make a similar point in their estimation of price elasticities for alcohol and tobacco in India.

Table C 3: Unit Value Regressions for Wave 1

VARIABLES	Log UV	Log UV	Log UV	Log UV
(1)	(2)	(3)	(4)	
H/hold Expendditure	0.210***	0.332***	0.398***	0.207***
	(0.0568)	(0.0723)	(0.110)	(0.0616)
H/Hold Size	-0.568***	-0.644***	-0.325	-0.254*
	(0.123)	(0.159)	(0.243)	(0.133)
Prop of Adults	-1.209***	-0.884**	-0.463	-0.454
	(0.300)	(0.366)	(0.642)	(0.327)
Prop of Males	-0.120	0.311	-0.0626	0.0551
	(0.240)	(0.310)	(0.535)	(0.250)
Dummy Tribal Auth.	-0.323**	-0.297*	0.205	-0.159
	(0.135)	(0.175)	(0.279)	(0.145)
Dummy Urban	-0.177	-0.378*	-0.00153	0.0563
	(0.170)	(0.220)	(0.328)	(0.181)
H/Hold Male	0.146	0.180	-0.0935	0.156
	(0.171)	(0.201)	(0.371)	(0.184)
Marital Stat. of Head	0.146	0.0125	-0.103	0.179
	(0.128)	(0.148)	(0.283)	(0.140)
Coloured	0.0495	0.146	0.110	-0.182
	(0.147)	(0.165)	(0.393)	(0.157)
Indian	0.954***	-0.614	0.483	0.575
	(0.366)	(0.810)	(0.797)	(0.361)
White	0.257	0.117	0.320	-0.142
	(0.178)	(0.250)	(0.393)	(0.185)
Primary Incomplete	0.252	0.180	0.0847	0.0691
	(0.172)	(0.231)	(0.354)	(0.185)
Primary Complete	0.288	0.259	0.469	0.391
	(0.225)	(0.256)	(0.406)	(0.257)
Secondary Incomp.	0.639***	0.224	0.605*	0.481***
	(0.168)	(0.206)	(0.338)	(0.181)
Matric	0.809***	0.576**	0.598	0.692***
	(0.187)	(0.230)	(0.387)	(0.200)
Tertiary	0.988***	0.938**	1.159**	0.801***
	(0.276)	(0.396)	(0.560)	(0.289)
Constant	0.590	-1.674**	-3.889***	0.257
	(0.603)	(0.729)	(1.246)	(0.660)
Observations	1,038	189	117	732
R-squared	0.143	0.402	0.470	0.117

Table C3 shows results of the unit value regressions corresponding to equation C2 for Wave 1. Column 1 is for the full sample, column 2 for binge drinkers, column 3 for other heavy drinkers and column 4 for moderate drinkers. ***, **, * signify statistical significance at the 1%, 5% and 10% level respectively. Standard errors are in parenthesis.

Table C 4: Unit Value Regressions for Wave 3

VARIABLES	Log UV (1)	Log UV (2)	Log UV (3)	Log UV (4)
H/Hold Expenditure	0.185***	0.270***	0.314***	0.197***
	(0.0451)	(0.0574)	(0.112)	(0.0452)
H/Hold Size	-0.469***	-0.123	-0.0665	-0.160*
	(0.0827)	(0.0982)	(0.184)	(0.0867)
Proportion of adults	-0.600***	-0.122	0.172	-0.0499
	(0.216)	(0.266)	(0.434)	(0.224)
Proportion of Males	-0.0806	0.514**	-0.0157	0.263
	(0.164)	(0.216)	(0.379)	(0.164)
Dummy Tribal Auth.	0.0903	-0.127	-0.0735	0.164
	(0.100)	(0.124)	(0.188)	(0.104)
Dummy Urban	-0.230	-0.149	0.115	-0.187
	(0.146)	(0.177)	(0.286)	(0.152)
H/hold Head Male	-0.0214	0.0117	0.103	-0.0835
	(0.0946)	(0.121)	(0.183)	(0.0974)
Married Stat. of Head	0.101	-0.0886	0.00807	0.0753
	(0.0829)	(0.104)	(0.173)	(0.0845)
Coloured	-0.155	0.0359	0.139	-0.108
	(0.0982)	(0.114)	(0.209)	(0.103)
Indian	0.504	0.861	0.786	0.0452
	(0.367)	(0.861)	(0.725)	(0.340)
White	-0.00312	0.0199	0.388	-0.421***
	(0.155)	(0.294)	(0.474)	(0.144)
Primary Incomplete	-0.0159	0.174	0.154	-0.0171
	(0.138)	(0.176)	(0.248)	(0.142)
Primary Complete	-0.129	0.193	-0.176	0.151
	(0.166)	(0.196)	(0.295)	(0.180)
Secondary Incomp.	0.157	0.234	0.173	0.117
	(0.129)	(0.162)	(0.241)	(0.133)
Matric	0.453***	0.315*	0.509*	0.414***
	(0.144)	(0.189)	(0.294)	(0.146)
Tertiary	0.649***	0.598	0.893	0.363*
	(0.232)	(0.374)	(0.757)	(0.220)
Constant	1.148**	-1.623***	-3.355***	0.749
	(0.471)	(0.599)	(1.125)	(0.477)
Observations	1,615	352	174	1,089
R-squared	0.101	0.157	0.230	0.087

Table C4 shows results of the unit value regressions corresponding to equation C2 for Wave 3. Column 1 is for the full sample, column 2 for binge drinkers, column 3 for other heavy drinkers and column 4 for moderate drinkers. ***, **, * signify statistical significance at the 1%, 5% and 10% level respectively. Standard errors are in parenthesis.

Table C 5: Unit Value Regressions for Wave 4

VARIABLES	Log UV (1)	Log UV (2)	Log UV (3)	Log UV (4)
H/Hold Expenditure	0.383***	0.371***	0.258***	0.335***
	(0.0364)	(0.0507)	(0.0638)	(0.0368)
H/Hold Size	-0.691***	-0.460***	-0.0766	-0.329***
	(0.0697)	(0.0910)	(0.124)	(0.0744)
Proportion of adults	-1.018***	-0.548**	-0.0461	-0.253
	(0.179)	(0.244)	(0.316)	(0.185)
Proportion of Males	-0.375***	-0.135	0.507*	-0.0746
	(0.138)	(0.204)	(0.269)	(0.138)
Dummy Tribal Auth.	0.000445	-0.136	-0.200	0.0548
	(0.0837)	(0.110)	(0.137)	(0.0873)
Dummy Urban	0.379***	-0.123	0.533	0.213*
	(0.128)	(0.174)	(0.379)	(0.127)
H/Hold Heam Male	0.0397	0.137	-0.0593	-0.0913
	(0.0847)	(0.104)	(0.147)	(0.0894)
Marital Stat. Head	0.159**	0.0189	0.307**	0.128*
	(0.0715)	(0.0922)	(0.131)	(0.0736)
Coloured	-0.239***	-0.0303	0.248	-0.215**
	(0.0811)	(0.0980)	(0.159)	(0.0848)
Indian	0.225	0.255	-2.186**	0.0407
	(0.333)	(0.853)	(0.904)	(0.296)
White	-0.243*	0.144	0.0216	-0.423***
	(0.144)	(0.272)	(0.305)	(0.135)
Primary Incomplete	-0.0949	0.0562	0.0829	0.0357
	(0.121)	(0.159)	(0.188)	(0.127)
Primary Complete	-0.0523	0.285	-0.312	-0.165
	(0.157)	(0.195)	(0.286)	(0.164)
Secondary Incomp.	0.219**	0.310**	0.398**	0.206*
	(0.109)	(0.144)	(0.183)	(0.113)
Matric	0.446***	0.330**	0.586***	0.458***
	(0.123)	(0.164)	(0.215)	(0.126)
Tertiary	0.462**	0.109	1.240***	0.329*
	(0.209)	(0.353)	(0.462)	(0.200)
Constant	-0.146	-1.567***	-2.813***	-0.0955
	(0.395)	(0.573)	(0.695)	(0.398)
Observations	1,991	453	218	1,320
R-squared	0.171	0.242	0.330	0.149

Table C5 shows results of the unit value regressions corresponding to equation C2 for Wave 4. Column 1 is for the full sample, column 2 for binge drinkers, column 3 for other heavy drinkers and column 4 for moderate drinkers. ***, **, * signify statistical significance at the 1%, 5% and 10% level respectively. Standard errors are in parenthesis.

Table C 6: Budget Share regressions for Wave 1

VARIABLES	W	w	w	w
	(1)	(2)	(3)	(4)
H/Hold Expenditure	-0.0738***	-0.0799***	-0.0785*	-0.0574***
	(0.0110)	(0.0294)	(0.0415)	(0.0152)
H/Hold Size	-0.0242	-0.0193	0.0705	-0.0350
	(0.0232)	(0.0523)	(0.116)	(0.0310)
Proportion of adults	-0.0237	-0.0180	0.323*	-0.0208
	(0.0539)	(0.125)	(0.177)	(0.0744)
Proportion of males	0.0711*	0.139	-0.618**	0.0767
	(0.0418)	(0.107)	(0.283)	(0.0560)
Dummy Tribal Auth.	0.0468	0.0136		0.107
	(0.0841)	(0.137)		(0.119)
Dummy Urban	-0.0128		0.0327	0.0657
	(0.0875)		(0.187)	(0.122)
H/Hold Male	0.00284	-0.0471	0.474*	-0.0139
	(0.0300)	(0.0771)	(0.270)	(0.0410)
Marital Stat. Head	0.0205	0.00622	-0.280	0.0436
	(0.0226)	(0.0560)	(0.189)	(0.0317)
Coloured	-0.0272	-0.0531	0.0432	-0.0678
	(0.0459)	(0.0827)	(0.260)	(0.0715)
Indian	0.00589			-0.0342
	(0.0789)			(0.0961)
White	-0.0318	0.0589		-0.0773
	(0.0483)	(0.104)		(0.0675)
Primary Incomplete	0.00271	0.110	-0.109	-0.0405
	(0.0295)	(0.0820)	(0.128)	(0.0401)
Primary Complete	0.0513	0.0327	0.111	0.0343
	(0.0400)	(0.0877)	(0.154)	(0.0585)
Secondary Incomp.	0.0225	0.162**	0.0934	-0.00668
	(0.0306)	(0.0690)	(0.168)	(0.0422)
Matric	0.0906***	0.230***	0.164	0.0663
	(0.0346)	(0.0791)	(0.172)	(0.0487)
Tertiary	0.0986*	0.275**	-0.0251	0.0625
	(0.0520)	(0.122)	(0.247)	(0.0688)
Constant	0.782***	0.752**	0.752*	0.612***
	(0.129)	(0.301)	(0.356)	(0.178)
Observations	1,199	190	117	892
R-squared	0.449	0.846	0.977	0.406

Table C6 shows results of the budget share regressions corresponding to equation C3 for Wave 1. Column 1 is for the full sample, column 2 for binge drinkers, column 3 for other heavy drinkers and column 4 for moderate drinkers. ***, **, * signify statistical significance at the 1%, 5% and 10% level respectively. Standard errors are in parenthesis.

Table C 7: Budget Share regressions for Wave 3

VARIABLES	W	w	w	w
	(1)	(2)	(3)	(4)
H/Hold Expenditure	-0.0950***	-0.117***	-0.134	-0.0917***
	(0.00701)	(0.0208)	(0.155)	(0.00695)
H/Hold Size	0.0189	-0.0509	0.294	0.0185
	(0.0123)	(0.0383)	(0.185)	(0.0124)
Proportion of adults	0.0333	-0.0191	0.813*	0.00136
	(0.0315)	(0.0897)	(0.441)	(0.0317)
Proportion of Males	0.0738***	0.0445	0.735*	0.0461**
	(0.0235)	(0.0850)	(0.370)	(0.0227)
Dummy Tribal Auth.	0.0294	-0.265***	0.248	0.0658***
	(0.0251)	(0.0820)	(0.346)	(0.0247)
Dummy Urban	-0.00103	-0.229**	0.0596	0.0408
	(0.0352)	(0.109)	(0.450)	(0.0358)
H/Hold Head Male	-0.0146	0.0618	-0.271	-0.00480
	(0.0134)	(0.0435)	(0.198)	(0.0134)
Marital Stat. Head	-0.00738	-0.00198	-0.00149	-0.0135
	(0.0120)	(0.0352)	(0.182)	(0.0118)
Coloured	0.00230	0.0196	0.123	0.0182
	(0.0305)	(0.109)	(0.280)	(0.0307)
Indian	0.0469			0.0396
	(0.0881)			(0.0747)
White	0.0569	-0.00211		0.0627*
	(0.0423)	(0.223)		(0.0377)
Primary Incomplete	0.0217	0.00509	-0.393*	0.0452**
	(0.0206)	(0.0639)	(0.222)	(0.0207)
Primary Complete	0.0832***	0.156**	0.159	0.0501*
	(0.0250)	(0.0658)	(0.282)	(0.0263)
Secondary Incomp.	0.0347*	0.0731	-0.336	0.0595***
	(0.0198)	(0.0604)	(0.239)	(0.0200)
Matric	0.0447**	0.107	-0.203	0.0688***
	(0.0222)	(0.0739)	(0.292)	(0.0218)
Tertiary	0.0634*	0.0818	-0.292	0.103***
	(0.0347)	(0.148)	(0.772)	(0.0321)
Constant	0.963***	1.487***	0.328	0.901***
	(0.0753)	(0.233)	(1.554)	(0.0749)
Observations	1,876	352	174	1,350
R-squared	0.338	0.665	0.709	0.469

Table C7 shows results of the budget share regressions corresponding to equation C3 for Wave 3. Column 1 is for the full sample, column 2 for binge drinkers, column 3 for other heavy drinkers and column 4 for moderate drinkers. ***, **, * signify statistical significance at the 1%, 5% and 10% level respectively. Standard errors are in parenthesis.

Table C 8: Budget Share regressions for Wave 4

VARIABLES	w	w	w	w
	(1)	(2)	(3)	(4)
H/Hold Expenditure	-0.415***	-0.127***	-0.139***	-0.569***
	(0.0350)	(0.0175)	(0.0310)	(0.0534)
H/Hold Size	0.0883	-0.0285	-0.0481	0.175*
	(0.0645)	(0.0301)	(0.0699)	(0.102)
Proportion of Adults	-0.0522	-0.0630	-0.0728	-0.0298
	(0.163)	(0.0853)	(0.166)	(0.252)
Proportion of Males	0.182	0.0324	0.0465	0.308*
	(0.125)	(0.0691)	(0.133)	(0.183)
Dummy Tribal Auth.	0.0871	0.0810	-0.0255	0.127
	(0.103)	(0.0611)	(0.132)	(0.153)
Dummy Urban	0.132	0.0698	0.116	0.189
	(0.157)	(0.0768)	(0.223)	(0.236)
H/Hold Head Male	-0.116	-0.0161	0.0706	-0.200*
	(0.0778)	(0.0342)	(0.0765)	(0.121)
Marital Stat. Head	0.144**	0.0643**	0.0304	0.214**
	(0.0664)	(0.0315)	(0.0702)	(0.102)
Coloured	-0.168	0.00477	0.138	-0.330
	(0.158)	(0.0574)	(0.176)	(0.249)
Indian	0.142			0.192
	(0.451)			(0.565)
White	0.136			0.144
	(0.241)			(0.327)
Primary Incomplete	-0.00547	-0.0190	-0.0544	-0.0656
	(0.115)	(0.0542)	(0.106)	(0.180)
Primary Complete	0.0582	0.0214	0.184	0.0659
	(0.143)	(0.0621)	(0.157)	(0.222)
Secondary Incomp.	0.0929	0.00632	0.0127	0.159
	(0.108)	(0.0519)	(0.100)	(0.165)
Matric	0.426***	-0.00612	0.0667	0.607***
	(0.120)	(0.0598)	(0.118)	(0.182)
Tertiary	0.545***	-0.0229		0.767***
	(0.201)	(0.106)		(0.289)
Constant	4.028***	1.443***	1.597***	5.359***
	(0.382)	(0.202)	(0.350)	(0.576)
Observations	2,192	453	218	1,521
R-squared	0.193	0.699	0.727	0.234

Table C8 shows results of the budget share regressions corresponding to equation C3 for Wave 4. Column 1 is for the full sample, column 2 for binge drinkers, column 3 for other heavy drinkers and column 4 for moderate drinkers. ***, **, * signify statistical significance at the 1%, 5% and 10% level respectively. Standard errors are in parenthesis.

Appendix D: A Simulation Model for a Provincial Excise Tax for the Western Cape

Introduction

Alcohol has been subject to excise taxes in South Africa since at least 1910. The tax has always been levied at the national level. As far as we are aware, none of the provinces have imposed excise taxes on alcohol products in the past century.

The thinking behind using excise tax increases as a means to reduce alcohol consumption is relatively simple. By increasing the excise tax, the government increases the cost of producing alcohol. The increased costs are passed on to the consumers in the form of higher prices. The law of demand predicts that an increase in the price of a product will decrease the quantity demanded for that product, which ultimately leads to a reduction in consumption of that product.

There are two crucial links in this mechanism. The first one is that producers of the product pass the tax increases through to consumers in the form of higher prices. The second is that consumers do in fact change their purchasing behaviour in response to higher prices of the product.

There is a substantial literature that investigates the pass-through of taxes to retail prices, not only for alcohol, but also for other products (Russell and Van Walbeek, 2016). The issue is typically not whether a tax increase results in higher retail prices (it does), but rather by *how much* the retail price increases in response to an increase in the excise tax. In a fairly comprehensive literature review, Russell and Van Walbeek (2016) find that, for alcohol, the excise tax is often over-shifted. This means that the retail price increases by more than the absolute increase in the excise tax. In an empirical analysis on tax pass-through for beer in South Africa, they find that the excise tax is substantially over-shifted in the period of analysis (2001-2015).

In a modelling scenario, one of the crucial parameters is the degree of pass-through that one can expect. Most modelling exercises assume a pass-through factor of 1, which means that for every R1 increase in the excise tax, the (net-of-VAT) retail price increases by R1 (Van Walbeek, 2010). If the VAT (currently 15%) is levied on the excise tax as well, as is the case in South Africa, the retail price would be expected to increase by R1.15, if there is full pass-through. In practice this is probably a conservative estimate of the degree of pass-through. If the pass-through coefficient (net of the VAT effect) is more than 1, the price increase is amplified by the manufacturer, with positive public health consequences. The price would *increase* by more, and alcohol use would *decrease* by more than predicted by the model.

The second crucial parameter is the price elasticity of demand. Any analysis that considers using the price mechanism to change behaviour pivots on the accuracy of this parameter. An international review of the price elasticity of demand for alcohol products, and the estimation of the price elasticity of demand for alcohol in South Africa, has clearly shown that the price elasticity of demand for alcohol falls in the relatively inelastic range. Thus an increase in the retail price of alcohol would cause a decrease in the consumption of alcohol, but the decrease in consumption is proportionally smaller than the increase in the price.

Had the price elasticity of demand been zero, it would imply that people do not change the quantity of alcohol that they consume when faced with a change in the price. While this may be true for some individuals, for example the very rich, or the very addicted, there is no evidence that this is true for

large groups of people. As a general rule, there is overwhelming evidence that an increase in the retail price of alcohol results in a decrease in alcohol consumption.

However, some groups of people are more price responsive than others. We see this for alcohol, but also for other products. For example, a very consistent finding from the tobacco control literature is that young and poorer people have a more price-sensitive demand for tobacco products than the general population (IARC, 2011). In this report, the focus is on binge/high episodic drinking and other heavy drinking. In section 4 we estimate the price elasticity of demand for alcohol for different categories of drinkers, for different waves of NIDS data, and find the that price elasticity of demand for binge drinkers is between -0.2 and -0.25, for other heavy drinkers between -0.15 and -0.2, and for moderate drinkers about -0.4.

The modelling exercise that aims to investigate the likely impact of a province-specific excise tax on alcohol broadly follows the methodology of the Tobacco Excise Tax Simulation Model (TETSiM), which is described in Van Walbeek (2010). The model consists of a set of mathematical equations. These equations define the relationship between excise tax, retail price, consumption, total expenditure by consumers, and government revenue. Once the mathematical relationships are in place, the user of the model populates it with the appropriate parameters. These parameters are described in more detail below. In the base scenario one attempts to approximate reality as closely as possible. For example, how much alcohol is consumed in the Western Cape? What is the composition of consumption by alcohol category? What proportion of alcohol is consumed by binge drinkers, as opposed to other kinds of drinkers? Etc.

The model's parameters need to be calibrated, based on real-world data. Our main source of data has been NIDS waves 1, 3 and 4, and the All Media and Product Survey of 2014. We have also used the 2018/19 Budget Review, published by National Treasury (2018), especially where absolute magnitudes of alcohol-related variables are important.

Once the base scenario is in place, one "shocks" the system. In this instance the "shock" is the imposition of a province-specific excise tax. This shock increases the retail prices of alcohol, which in turn are expected to change people's consumption patterns. Changes in consumption will change total expenditure on alcohol, and therefore excise tax revenue. The magnitude of the change in consumption, expenditure, and government revenue is determined by the parameters of the model.

The workings of the simulation model

The model is programmed in Excel and is available with this report. The user can change any of the parameters on the Input sheet. All the numbers that appear on the two Output sheets are derived from the inputs. The user should not make any changes to the Output sheets.

Because alcohol consumption is so under-reported in surveys, including NIDS, our primary source of information for this section of the work is tax-paid revenue data collected by SARS and reported in the Budget Review (National Treasury, 2018). We used the most recent estimates of national excise tax revenue (2017/18 financial year) and the excise taxes that were applicable in this year (R86.39 per litre of absolute alcohol for beer, R3.61 per litre of beverage (irrespective of alcohol content) for wine, and R175.19 per litre of absolute alcohol for spirits) to calculate the quantities of alcohol that were consumed in each of these three categories. We ignored sorghum beer because it contributes only a

tiny percentage (less than 0.5%) of total tax-paid alcohol use in South Africa. Alcoholic beverages like ciders, sparkling wine and coolers are categorised under "wine and other fermented beverages". For the sake of simplicity and traceability, we treat all the products under this category, for tax purposes, as wine.

For the country as a whole, a total of 315.7 million litres of absolute alcohol was consumed, of which 153.5 million litres (48.6% of total) were beer, 125.3 million litres (39.7% of total) were "wine and other fermented beverages" (henceforth termed "wine"), and 36.9 million litres (11.7% of total) were spirits. The actual quantities of beverage consumed are approximately 3070 million litres of beer (assuming an average alcohol content of 5%), 1044 million litres of wine (assuming an average alcohol content of 12%) and 86 million litres of spirits (assuming an average alcohol content of 43%). In the analysis below we typically focus on the quantity of absolute alcohol, because that is how the excise tax on beer and spirits is levied.

According to 2014 AMPS data, the Western Cape's share of the country's total alcohol consumption is estimated at about 11.3%. The Western Cape's share of total alcohol consumption, according to NIDS, decreased from 16.4% in 2008 to 14.2% in 2012 and increased again to 15.1% in 2014. For the purposes of this model we estimate that the Western Cape consumes 15% of total alcohol consumed in South Africa, for a total of 47.4 million litres of absolute alcohol.

As was shown in section 2 of the report, the relative composition of the alcohol categories in the Western Cape differs from that of the country as a whole. Given the historical importance of wine production in the Western Cape, it is no surprise that the relative share of wine in total alcohol consumption is larger than the national average. In fact, in Table 3 of the main report we saw that the index of use for wine was substantially higher than the country average, while it the index of use was substantially lower for beer. The model allows the user to change the relative composition of the alcohol categories that are consumed in the province under discussion. Based on this intuition, and in order to align the relative shares of the three alcohol categories in the Western Cape broadly with the AMPS data that was shown in Table 3 of the main report, we decreased the share of beer consumption in total alcohol consumption in the Western Cape by 7 percentage points (from 48.6% to 41.6%), and of spirits by 1 percentage point (from 11.7% to 10.7%), while increasing the share of wine by 8 percentage points (from 39.7% to 47.7%). The numbers that are underlined are easily variable by the user in the Excel sheet.

We decompose the alcohol drinking population into three categories, namely (1) binge drinkers, (2) other heavy drinkers, and (3) moderate drinkers. Based on the NIDS survey, and using the definitions of drinking discussed in the main report, we find that the proportion of alcohol that is consumed by (irregular) binge drinkers is 25.4% across the three waves [24.2% in wave 1, 24.8% in wave 3 and 27.3% in wave 4]. The volume of alcohol consumed by other heavy drinkers is 49.7% across the three waves [47.7% in wave 1, 51.2% in wave 3, and 50.3% in wave 4]. The volume consumed by moderate drinkers is 24.9% [28.1% in wave 1, 24.0% in wave 3 and 22.5% in wave 4]. Although we see a relatively strong trend away from moderate drinking to binge drinking between 2008 (wave 1) and 2014 (wave 4), we used the average of the three waves in the model. Note that we are not saying that 25.4% of drinkers in the Western Cape are binge drinkers and that 50.3% of drinkers are other heavy drinkers, but rather that 25.4% of alcohol consumed in the Western Cape is consumed by irregular binge drinkers and that another 50.3% of alcohol is consumed by other heavy drinkers.

In the same way that the composition of the "alcohol basket" in the Western Cape could differ from the national "alcohol basket", it seems likely that the composition of the "alcohol basket" for binge drinkers differs from those of other heavy drinkers and moderate drinkers. Although we have not investigated this empirically, the model allows one to take cognisance of this. Thus, based on stereotypes, it seems plausible that, in their "alcohol basket", binge drinkers are likely to drink relatively more beer and relatively less wine and spirits than the average drinker in the province. In the same vein, it seems plausible that other heavy drinkers are likely to drink relatively more spirits and relatively less beer and wine than the average drinker in the province. By implication, moderate drinkers, who act as a balancing group in the model, would thus drink relatively more wine than the other groups.

On the basis of these inputs, one can then compile a matrix, which shows the quantities of absolute alcohol that are consumed by the three different groups of drinkers, in the three different categories of alcohol, together with the respective totals. This is shown in Table D1 below. This forms the base scenario in terms of consumption patterns at the outset.

Table D 1: Quantities of absolute alcohol consumed by different groups of drinkers in the Western Cape (million litres)

	Beer	Wine	Spirits	Total
Binge drinkers	5.61	5.37	1.05	12.03
Other heavy drinkers	8.62	11.22	3.70	23.54
Moderate drinkers	5.48	5.98	0.33	11.79
Total	19.71	22.58	5.07	47.35

Notes: These numbers are subject to the assumptions described in the text, which can be changed by the user. The numbers are based on data obtained from the National Treasury's Budget Review, NIDS waves 1,3 and 4, and AMPS, 2014.

The other important aspect of the analysis concerns the price of alcohol. While the analysis that underlay the estimation of price elasticities, described in Appendix C, took advantage of the fact that there is variation in unit values, caused by, among other things, transport costs and differences in perceived quality, this analysis considers *average* prices of the three categories of alcohol. Based on the fact that National Treasury targets a total tax burden for each of the three alcohol categories (35% for beer, 23% for wine and 48% for spirits) and that the excise tax is levied as a specific tax, one can easily calculate the average price for each of these three categories of consumption. For beer this is R19.67 per litre (R14.75 per 750 ml bottle), for wine R36.26 per litre (R27.19 per 750 ml bottle) and for spirits R215.50 per litre (R161.63 per 750 ml bottle).

In the base scenario, the average retail prices of the three alcohol categories are decomposed into three components: (1) VAT, (2) the excise tax (which is levied at the national level), and (3) the remainder, which we call the net-of-tax price. The net-of-tax price is distributed across the full value chain, i.e. the manufacturer, wholesaler, retailer, logistics providers, and all other service providers. We do not break down the net-of-tax price into the finer components, because it does not serve any purpose in the analysis.

The decomposition of the average retail price for the three alcohol categories in the base scenario is shown in Table D2 below. The total tax burden (i.e. excise tax plus VAT, as a percentage of the average retail price) is 35% for beer, 23% for wine, and 48% for spirits.

Table D 2: Decomposition of the average retail price in the base scenario (per litre), in 2017/18

	Beer	Wine	Spirits
Net-of-tax price	12.79	27.92	112.06
Excise tax (national)	4.32	3.61	75.33
Excise tax (provincial)			
VAT	2.57	4.73	28.11
Average retail price (per litre)	19.67	36.26	215.50
Average retail price (per 750 ml)	14.75	27.19	161.63
Excise tax burden	22.0	10.0	35.0
Total tax burden	35.0	23.0	48.0

Source: Derived from Budget Review (National Treasury, 2018)

In the next step the model is "shocked" with the introduction of a provincial excise tax. Given the exploratory nature of this report, the values of these province-specific excise taxes are arbitrary. The user can change these values in the Inputs sheets of the Excel spreadsheet. Consistent with national excise taxes, we assume that the provincial excise tax will be levied as a specific tax. The numbers we have chosen, but which are changeable, are R20 per litre of absolute alcohol for beer, R1.00 per litre of beverage for wine (irrespective of alcohol content) and R50 per litre of absolute alcohol for spirits.

As discussed in the Introduction to this Appendix, it is conceivable, and even likely, that the alcohol industry would change the net-of-tax price at the same time as the excise tax is increased, or, in this case, when a new excise tax is imposed. The competitive environment has a significant impact on whether the industry can increase the net-of-tax price (i.e. over-shift the excise tax increase) or decrease the net-of-tax price (under-shift the excise tax increase). As a general rule, firms operating in a more concentrated, less competitive environment are able to over-shift the excise tax increase more easily than firms that operate in a more competitive environment. For cigarettes, the tobacco industry over-shifted the excise tax before 2010, but under-shifted the excise tax subsequently as the market became more competitive with the appearance of large numbers of low-cost producers.

The general practice in modelling studies is to assume that the tax is fully passed through. This means that the net-of tax price remains unchanged after the increase of the excise tax. However, to illustrate the flexibility of the model, we assume that the alcohol industry increases the net-of tax price by 5% for beer, 3% for wine and 2% for spirits. Generally, if a producer has substantial market power, it is in a stronger position to use that power to set the net-of-tax price.

The sum of the net-of-tax price, the national excise tax and the provincial tax is subject to VAT, which is currently 15%, but which can be changed in the model.

All the price components are added together to produce a new average retail price, for each of the three alcohol categories. The new decomposition of the retail price is shown in Table D3 below.

Table D 3: Decomposition of the average retail price after the imposition of a provincial excise tax (per litre), using 2017/18 values

	Beer	Wine	Spirits
Net-of-tax price	13.43	28.76	114.30
Excise tax (national)	4.32	3.61	75.33
Excise tax (provincial)	1.00	1.00	21.50
VAT	2.81	5.00	31.67
Average retail price (per litre)	21.56	38.37	242.80
Average retail price (per 750 ml)	16.17	28.78	182.10
Excise tax burden	24.7	12.0	39.9
Total tax burden	37.7	25.1	52.9

Note: The assumed provincial excise tax is R20 per litre of absolute alcohol for beer, R1.00 per litre of wine and R50 per litre of absolute alcohol for spirits

Consumers typically have very little interest in, or understanding of, the composition of the retail price. Their interest is in the level of the retail price, and in changes in the retail price. Changes in the retail price change consumer behaviour. The imposition of the provincial excise tax, together with the assumed change in the net-of-tax price, as discussed above, yields a 9.6% increase in the retail price of beer, 5.8% increase in the price of wine, and 12.7% increase in the price of spirits.

These price changes change the purchasing behaviour of alcohol consumers, but by different proportions for the different categories of users (i.e. binge drinkers, other heavy drinkers and moderate drinkers). In section 4 we found that, in line with international experience, moderate drinkers are substantially more price sensitive than binge drinkers and other heavy drinkers. In other words, the price elasticity of demand for alcohol is substantially higher (in absolute terms) for moderate drinkers than for binge drinkers and other heavy drinkers. Unfortunately, the data did not allow us to estimate the price elasticity of demand separately for beer, wine and spirits. While the model is programmed to cater for different elasticities for beer, wine and spirits, we decided, in the absence of any better information, to keep the price elasticities the same for the three alcohol categories, but to differentiate them by category of drinker. Thus, based on the analysis presented in section 4 we assumed that the price elasticity of demand for binge drinkers is -0.22 (for all alcohol categories), for other heavy drinkers it is -0.18, and for moderate drinkers it is -0.4.

The combination of the price elasticity of demand and the percentage increase in the retail price of alcohol allows us to estimate the new quantities, and the percentage change in the quantities, by beverage category and by type of drinker. The new quantities are shown in Table D4 and the percentage changes in the quantities are shown in Table D5.

Table D 4: Quantities of absolute alcohol consumed in the Western Cape after the imposition of a province-specific excise tax (million litres)

	Beer	Wine	Spirits	Total
Binge drinkers	5.47	5.30	1.01	11.78
Other heavy drinkers	8.47	11.11	3.61	23.18
Moderate drinkers	5.27	5.84	0.31	11.43
Total	19.21	22.25	4.93	46.39

Table D 5: Percentage change in alcohol consumption in the Western Cape after the imposition of a province-specific excise tax

	Beer	Wine	Spirits	Total
Binge drinkers	-2.4	-1.5	-3.2	-2.0
Other heavy drinkers	-1.7	-1.0	-2.3	-1.5
Moderate drinkers	-3.8	-2.3	-5.1	-3.1
Total	-2.5	-1.5	-2.6	-2.0

It is clear that the impact of the provincial excise tax will decrease alcohol consumption among all groups, but that it will have a greater impact on the consumption of moderate drinkers. Based on the assumptions used in this exercise, total alcohol consumption is expected to decrease by 2% among binge drinkers, 1.5% among other heavy drinkers and 3.1% among moderate drinkers. The fact that alcohol consumption by moderate drinkers decreases by a larger percentage than other categories of drinkers is unsurprising because moderate drinkers are more price sensitive than binge drinkers and other heavy drinkers.

Increasing the excise tax on "sin goods" like alcohol and tobacco has often been described as a blunt instrument, on account of the fact that it is not very good at targeting the people and behaviour that it is intended to target. We see this here as well. While the aim of increasing the excise tax is primarily to reduce alcohol consumption by binge and other heavy drinkers, it is moderate drinkers who decrease their consumption by the largest percentage.

Revenue considerations

The last section of the model considers the revenue aspects of the excise tax. Because the retail price of alcohol can be subdivided into the net-of-tax component, the excise tax (initially only the national tax but, after the assumed imposition of the provincial tax, also the provincial excise tax) and VAT, one can easily estimate the revenue components by multiplying the relevant price component with the appropriate quantity. The revenue components in the base scenario are shown in Table D6. Note that these revenues refer only to the Western Cape's share.

Table D 6: Alcohol-related revenues based on consumption in the Western Cape, in the base scenario (R millions)

	Beer	Wine	Spirits	Total
Industry revenue (based on net-of-tax price)	5 040	5 254	1 321	11 614
Excise tax revenue (national)	1 702	679	888	3 269
Excise tax revenue (provincial)	0	0	0	0
VAT	1 011	890	331	2 233
Total expenditure by consumers	7 753	6 823	2 540	17 116

Please note that "industry revenue" is not just the revenue of the manufacturers of alcohol, but includes the revenues of all firms involved in the value chain.

In Table D7 we estimate the revenues after the imposition of a provincial excise tax, also assuming that the alcohol industry has increased the net-of-tax price by a small percentage.

Table D 7: Alcohol-related revenues based on consumption in the Western Cape, after the imposition of a provincial excise tax (R millions)

	Beer	Wine	Spirits	Total
Industry revenue (based on net-of-tax price)	5 159	5 331	1 312	11 801
Excise tax revenue (national)	1 660	669	864	3 193
Excise tax revenue (provincial)	384	185	247	816
VAT	1 080	928	363	2 372
Total expenditure by consumers	8 284	7 113	2 786	18 183

Of course, the precise magnitudes of the changes in the revenues that accrue to the various players are sensitive to the underlying assumptions that are used in the model, but one can certainly make some general comments that are true under most assumptions.

The first general finding is that the total expenditure of consumers of alcohol will increase when the provincial excise is imposed. This result derived from the fact that the demand for alcohol, across all categories of users, is price inelastic.

The second finding is that the excise tax revenue collected by the national government will decrease in line with the decrease in consumption of alcohol. In the analysis we hold all other things constant and thus assume that the national government will not change the excise tax when the provincial tax is imposed. However, the decrease in the excise tax that goes to the national government is largely offset by an increase in VAT revenue (which also accrues to national government). In this example the sum of VAT and national excise tax revenue increased slightly from R5502 million to R5565 million after the imposition of the provincial excise tax.

The third finding is that the province can raise a substantial amount of revenue by implementing a provincial excise tax. In this example, this amount is nearly R816 million, but this amount is determined nearly exclusively by the amount of the excise tax imposed.

Lastly, the most difficult revenue to estimate is the industry's revenue. In this example, industry revenue has decreased slightly. In a scenario where the tax increases and consumption decreases as a result, one would expect a decrease in the revenue of the industry. However, to the extent that the firms in the industry have control over the net-of-tax price, they can mitigate the impact of the tax increases by increasing the net-of-tax price. In this example, we assumed that the alcohol industry increased the net-of-tax price of beer by 5%, of wine by 3%, and of spirits by 2%. If the industry were able to raise the net-of-tax price by higher percentages, they would be able to raise more revenue, possibly to an even higher level than they had raised before the imposition of the provincial excise tax. In the tobacco industry, British American Tobacco used their market power to raise the net-of tax price substantially between 1993 and 2010. Despite very large increases in the excise tax and a one-third reduction in cigarette volumes sold in South Africa, the real (inflation-adjusted) revenues that accrued to the tobacco industry in 2010 were substantially greater than in the early 1990s.

Appendix E: A Simulation Model for a Minimum Unit Price for the Western Cape

Since May 2018, all alcohol sold in Scotland is subject to a minimum unit price. The minimum price was set at 50 pence per unit of alcohol (about 8 grams). This comes to about 1 GBP per 330 ml can of beer. For very cheap products the price was expected to increase by more than 150%. For example, for a 2 litre bottle of very cheap cider, the price was expected to increase from 1.99 GBP to 5 GBP[6]. Our understanding is that the government of Scotland does not have the legal power to implement a Scotland-specific excise tax, and thus used the minimum unit price to reduce excessive alcohol consumption, especially of low-priced beverages.

While we appreciate that the data that underlies our analysis has significant flaws, such as underreporting of both the quantity consumed and expenditure on alcohol, and other errors in measurement, we found very strong empirical support for the thesis that different categories of drinkers (binge drinkers, other heavy drinkers and moderate drinkers) drink alcohol with substantially different unit values. The differences in the unit values presumably reflect large differences in quality. Table E1, which illustrates this for three different waves of NIDS, is derived as follows. We calculated a unit value for each alcohol-consuming household by dividing the total expenditure on alcohol by the household (obtained from the household questionnaire) by the sum of the reported consumption of the various members of the household (obtained from the questionnaires for adult individuals). Based on these unit values, we ranked households from the lowest to the highest unit value. Taking account of the total volume consumed by each of these households (and the survey weights), we then found the "overall median unit value". By construction, 50% of all alcohol consumed in the country is purchased at a unit value (price) of less than this "overall median unit value", while the other 50% of all alcohol consumed is purchased at a price greater than this "overall median unit value".

We then subdivided the households into binge drinkers, other heavy drinkers and moderate drinkers, based on a methodology that was discussed in section 4. For each of these categories of drinkers, we calculated what percentage of the total volume of reported alcohol had a unit value of less than a given percentage of the overall median unit value. We did this for every fifth percentile of the overall median unit value, but in Table E1 we report the cumulative percentages of the total volume of alcohol consumed at the 20^{th}, 40^{th}, 50^{th}, 60^{th}, 80^{th} and 100^{th} percentile of the overall median unit value.

[6] See: http://www.dailymail.co.uk/news/article-5677687/Scotland-imposes-minimum-alcohol-prices-sparking-warnings-English-booze-cruise.html

Table E 1: Percentage of total consumption consumed by different categories of alcohol consumers at unit values less than a specific percentage of the overall median unit value

	Irregular binge drinkers			Other heavy drinkers			Moderate drinkers		
Percentage of overall median unit value	2008 (W1)	2012 (W3)	2014 (W4)	2008 (W1)	2012 (W3)	2014 (W4)	2008 (W1)	2012 (W3)	2014 (W4)
<20%	6.1	2.7	1.1	18.9	25.3	21.8	2.8	1.2	0.2
<40%	11.4	4.7	6.4	34.4	47.3	41.7	6.5	3.3	0.8
<50%	16.2	6.4	11.6	37.5	54.6	46.4	7.7	4.2	0.9
<60%	24.6	10.3	13.9	46.8	58.2	52.8	10.4	5.4	5.2
<80%	28.6	18.9	20.6	64.3	74.1	67.0	16.1	10.9	8.2
<100%	37.0	24.6	26.9	73.9	80.4	79.5	21.0	12.2	13.0

Source: NIDS wave 1, 3 and 4

As a slight digression, we want to explain why we do not discuss and show the numerical value of the overall median unit value. We believe that this value is likely to be misleading and does not represent reality, but that the principle that we wish to demonstrate is still valid. The reason why we believe that the overall median unit value is likely to be misleading is that there is a very high degree of underreporting, both of alcohol consumption and of expenditure on alcohol, in the NIDS data. As was indicated in Appendix A, respondents in the NIDS survey underreport their alcohol consumption by a factor of between 4 and 5. The degree of underreporting of alcohol expenditure is even greater. We did not estimate the degree of underreporting in a rigorous way, but, based on some back-of-the envelope calculations, expenditure on alcohol seems to be underreported by a factor of at least 7. There may be multiple reasons for this, but it seems likely that people either genuinely "forgot" how much they spent on alcohol, or they do not want to acknowledge to the surveyor that they drink large quantities and spend a large proportion of their income on alcohol. Also, the respondent who completes the household questionnaire, where questions about the expenditure patterns of the household are asked, may not be aware of alcohol purchases by members of the household that do not pass through the "household budget", thus underrepresenting household expenditure on alcohol.

The result of all this underreporting (and to a greater degree for expenditure than consumption) is that the unit values are generally biased downwards. We hope that the degree of underreporting is broadly consistent across all types of alcohol consumers. If one group of consumers underreports their consumption or expenditure by a greater percentage than another group, this would result in some bias. Of course this is a concern, and does warn against putting too much faith in the results. However, given the consistency of the results (see below), and the fact that many studies make quite strong conclusions despite underreporting, we should not discard the approach.

To explain Table E1 in more detail, consider binge drinkers in wave 1. We see that 6.1% of all alcohol consumed by binge drinkers has a unit value (which can be interpreted as a price) of 20% or less of the overall median unit value of all alcohol consumers (not just of binge drinkers). Thus if the overall median reported unit value is R5, it means that 6.1% of all alcohol consumed by binge drinkers has a reported unit value of R1 or less. Using similar logic, 16.2% of all alcohol consumed by binge drinkers had a unit value of 50% of the overall median unit value or less, and 37% of all alcohol consumed by binge drinkers had a unit value equal to the overall median unit value or less. By implication, 63% of all alcohol consumed by binge drinkers had a unit value more than the overall median unit value.

The profile of heavy drinkers' unit values is completely different. In 2008, 37.5% of all alcohol consumed by heavy drinkers had a unit value less than 50% of the overall median unit value, and 73.9% of all alcohol consumed by heavy drinkers had a unit value of less than the overall median unit value. Clearly heavy drinkers were consuming alcohol that was significantly cheaper (and presumably of lower quality) than the alcohol consumed by irregular binge drinkers.

Only 7.7% of alcohol consumed by moderate drinkers in 2008 had a unit value of less than 50% of the overall median unit value, and only 21% of alcohol consumed by moderate drinkers had a unit value less than the overall median unit value. Thus, 79% of alcohol consumed by moderate drinkers had a unit value that was greater than the overall median unit value.

This analysis was performed for three waves of data, from 2008, 2012 and 2014. Although there are some minor differences, there is a high degree of consistency between the three waves. The most striking finding is that there are very large differences in the unit values that are paid by different categories of alcohol consumers. Heavy drinkers consistently purchase a much higher percentage of their total consumption at low unit values. At the other end, the proportion of alcohol purchased by moderate drinkers with a unit value below certain thresholds is the lowest of the three categories of drinkers. Binge drinkers' unit values are between those of other heavy drinkers and moderate drinkers, but are typically closer to those of moderate drinkers than other heavy drinkers.

In the analysis below, we abstract away from the magnitude of the unit value, and present a more conceptual analysis of the possible impact of a minimum unit price of alcohol. The analysis is presented in terms of a percentage of the overall median unit value.

We assume that the Western Cape Government sets the minimum price (unit value) as a percentage of the overall median unit price. The model allows the user to set this percentage. For illustrative purposes below, we initially set the minimum unit price at 50% of the median unit value, but we acknowledge that this is an arbitrary percentage. The government can set the minimum price higher or lower than 50% of the overall median unit value.

If such a minimum unit price is imposed, all prices (unit values) less than the minimum will be increased to this value. For very cheap product, say with a unit value of 10% of the overall median unit value, this would imply a very large [400% = ((50-10)/10 -1) x 100] increase in the price. So large a price increase will cause a substantial response in terms of consumption. The magnitude of the quantity response is determined by the value of the price elasticity of demand, and the relative size of the price change. For very large price changes, it is better to use the arc or midpoint formula, to determine the impact on the quantity demanded. The arc or midpoint formula is the price elasticity formula that is taught in most first-year texts: $= \frac{(Q_2-Q_1)}{(P_2-P_1)} \times \frac{(Q_1+Q_2)}{(P_1+P_2)}$, where *Q* indicates the quantity, *P* the price, ε the price elasticity of demand, the subscript 1 the initial values and the subscript 2 the final values. The "intuitive" version of the elasticity formula (i.e. percentage change in quantity, divided by the percentage change in the prices, where the percentage changes are calculated in the traditional manner, i.e. $\varepsilon = \frac{(Q_2-Q_1)}{Q_1} / \frac{(P_2-P_1)}{P_1}$) could result in mathematically impossible outcomes. For example, if the price was to increase by 400% and the price elasticity of demand is -0.5, this would suggest a 200% decrease in consumption, which is mathematically impossible. Consumption cannot decrease by more than 100%. Using the arc or midpoint formula, the decrease in consumption using these parameters would be 50%, which is more realistic.

For each alcohol-consuming household we calculated the unit value of the alcohol that they purchased and expressed this as a percentage of the overall median unit value. Households were categorised into three drinking categories (i.e. binge drinker, other heavy drinker and moderate drinker), using the established definitions. Based on the calculated unit values (expressed as a percentage of the median), we then put each household's declared consumption into different bins. The first bin was for unit values that were between 0 and 5% of the median unit value; the second bin was for unit values of between 5% and 10% of the median unit value, the third bin was for unit values of between 10% and 15% of the median unit value, and so forth. We created equal-sized bins up to 80% of the median unit value. It is important to note that we did not simply do a "headcount" of the households in each bin, but weighted each household by the total declared consumption of alcohol. Thus the analysis considers the quantity of alcohol consumed, rather than the number of alcohol consumers.

From the NIDS data we determined the share of total alcohol consumed by binge drinkers (25.4%), other heavy drinkers (49.7%) and moderate drinkers (24.9%). Because of the general underreporting of alcohol consumption in the NIDS survey, we derived the total alcohol consumption in the Western Cape using National Treasury data and the same methodology discussed in the previous analysis on the provincial excise tax.

As an illustration of how the model works, please see Table E2. This example refers to binge drinkers, using 2014 (i.e. NIDS wave 4) data. Column (2) shows the bin intervals, which are defined as the unit value of the alcohol consumed, expressed as a percentage of the overall median unit value. For the subsequent analysis we work with the top end of the bin range, i.e. the numbers shown in column (1). The user has to populate column (3), which is the cumulative percentage of alcohol consumed by this category of drinker, at the indicated percentages of the overall median unit value. These cumulative percentages are derived from the NIDS data. Column (4) is simply the share of total consumption that lies within a particular range of percentages of the median unit value. It is derived from column (3). Similarly, whereas column (4) indicates the *share* of total consumption of alcohol consumed in this unit value interval (for this category of drinkers), column (5) indicates the estimated number of litres consumed in this unit value interval. Column (5) is simply the value of column (4), multiplied by the total volume of absolute alcohol consumed in the Western Cape (47.35 million litres) and multiplied by the proportion of alcohol consumed by this category of drinkers (in this instance (for bingers) 25.4% of the total volume consumed).

Not shown in the table, but a crucial parameter in the model, is the minimum price, expressed as a percentage of the median unit value. The magnitude of this variable, which largely determines the effectiveness of a minimum price policy, would have to be debated and determined by the Western Cape government. In this instance we have set the minimum price at 50% of the median unit value, but we want to emphasise that this parameter is changeable. Column (6) is the heart of the analysis. To calculate the new level of consumption in each price range we require three inputs: (1) the initial value of consumption in that price range, as obtained in column (5), (2) the increase in the price required to reach the minimum price (i.e. 50% of the median unit value), and (3) the price elasticity of demand for this category of drinkers (-0.22 in this case). We use the arc/mid-point formula of the price elasticity of demand, to solve for the new quantity as follows:

$Q_2 = Q_1\,[1 + \varepsilon\,(P_2 - P_1)/(P_1 + P_2)]/[1 - \varepsilon\,(P_2 - P_1)/(P_1 + P_2)]$, where the symbols are as defined previously. Column (7) indicates the percentage change in consumption, for that price interval, as a result of this intervention.

Table E 2: Illustration of the minimum price model, binge drinkers, wave 4 (2014)

Percentage of the overall median unit value	Interval	Cumulative percentage of total consumption	Percentage of total consumption in this interval	Total consumption in this category (million litres of alcohol)	New consumption (million litres of alcohol)	Percentage change in consumption
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5	0-5	0.00	0.00	0.000	0.000	
10	5.01-10	0.07	0.07	0.008	0.006	-25.6
15	10.01-15	0.63	0.56	0.067	0.053	-21.2
20	15.01-20	1.06	0.43	0.052	0.043	-17.2
25	20.01-25	2.88	1.82	0.219	0.189	-13.7
30	25.01-30	4.09	1.21	0.146	0.130	-10.4
35	30.01-35	5.26	1.17	0.141	0.130	-7.5
40	35.01-40	6.41	1.15	0.138	0.132	-4.8
45	40.01-45	8.41	2.00	0.241	0.235	-2.3
50	45.01-50	11.62	3.21	0.386	0.386	0.0
55	50.01-55	12.18	0.56	0.067	0.067	0.0
60	55.01-60	13.91	1.73	0.208	0.208	0.0
65	60.01-65	16.53	2.62	0.315	0.315	0.0
70	65.01-70	18.19	1.66	0.200	0.200	0.0
75	70.01-75	19.22	1.03	0.124	0.124	0.0
80	75.01-80	20.60	1.38	0.166	0.166	0.0
100	80.01-100	26.91	6.31	0.759	0.759	0.0
	100.01 >	100.00	73.09	8.790	8.790	0.0
Total				12.027	11.934	-0.8

Unsurprisingly, the biggest change in alcohol consumption is predicted to be for those products with the lowest unit value at the outset (see column (7)). The percentage price change that will be brought about by the imposition of the minimum unit price will be greatest for these products. On the other hand, for alcohol products that are currently selling for more than the proposed minimum prices (i.e. for more than 50% of the overall median unit value), the imposition of the minimum unit price will not have any impact on consumption. We see that, in column (7), there is no percentage change in consumption for unit values that are greater than 50% of the overall median unit value. This is in line with economic theory, because a minimum price has no impact on prices that are already above the minimum.

The Total row indicates that this intervention is expected to reduce alcohol consumption by this category of consumers by 0.8%.

Using this methodology, we can determine the likely impact of a minimum unit price across the three categories of drinkers. We summarise the results below, but more detail can be found in the Excel spreadsheet.

Should the minimum price be set at 50% of the median unit value, the likely impact on consumption in the three categories of drinkers, for three waves of NIDS data is shown in Table E3. The price elasticity of demand is an input in the model, and is shown for illustrative purposes only.

Table E 3: Likely consequence of the imposition of a minimum unit price equal to 50% of the overall median unit price

	Binge drinkers	Other heavy drinkers	Moderate drinkers	Total
Price elasticity of demand	-0.22	-0.15	-0.4	
Percentage change in consumption				
Wave 1 (2008)	-1.60	-4.53	-1.75	-3.10
Wave 3 (2012)	-0.70	-5.42	-0.86	-3.09
Wave 4 (2014)	-0.77	-4.66	-0.17	-2.55

Although the impact on consumption differs from wave to wave, a consistent finding is that the imposition of a minimum unit price at 50% of the overall median unit value will have the largest impact on heavy drinkers. The impact on binge drinkers and moderate drinkers is broadly similar. The model predicts that, if the minimum price is set at 50% of the overall median unit value, total alcohol consumption would be expected to decrease by about 3%. The relative inelasticity of the demand for alcohol by heavy drinkers might suggest that they would not be sensitive to changes in the price, but the fact that such a large proportion of alcohol consumed by heavy drinkers would be affected by the minimum unit price makes a it a fairly strong and targeted tool to reduce heavy drinking.

In order to test the sensitivity of drinkers' consumption patterns to the imposition of a minimum price, we present two different scenarios in Table E4. In the first scenario the minimum price is set at 70% of the overall median unit value and in the second scenario it is set at 100% of the overall median unit value. In the first scenario total alcohol consumption is expected to decrease by about 4% and in the second scenario by about 6%. In both instances, as in the scenario presented in Table 10, the biggest impact of the minimum price is on heavy drinkers (decreases in consumption of about 6.5% and 9% respectively). The impact of the minimum unit price on binge drinkers and moderate drinkers is similar in waves 1 and 3, but somewhat greater on binge drinkers in wave 4.

Table E 4: Likely consequence of the imposition of a minimum unit price equal to 70% and 100% of the overall median unit price

	Binge drinkers	Other heavy drinkers	Moderate drinkers	Total
Minimum price equal to 70% of the overall median unit value				
Percentage change in consumption				
Wave 1 (2008)	-2.81	-6.06	-2.73	-4.41
Wave 3 (2012)	-1.27	-7.48	-1.37	-4.38
Wave 4 (2014)	-1.62	-6.55	-0.63	-3.82
Minimum price equal to 100% of the overall median unit value				
Percentage change in consumption				
Wave 1 (2008)	-4.46	-8.34	-4.27	-6.34
Wave 3 (2012)	-2.41	-9.99	-2.50	-6.20
Wave 4 (2014)	-2.87	-8.94	-1.52	-5.55

Our analysis suggests that a minimum unit price is a much sharper and more targeted instrument than a provincial excise tax. Whereas a provincial excise tax caused the largest decrease in alcohol consumption among moderate drinkers, a minimum unit price has by far the biggest impact on heavy drinkers. Moderate drinkers are substantially less affected by a minimum unit price than by an excise tax.

The effectiveness of the minimum unit price at curbing binge and other heavy drinking rests fundamentally on the observation that binge drinkers and other heavy drinkers drink alcohol with a much lower unit value, on average, than moderate drinkers. In fact, the whole analysis pivots on this. While we believe that we have calculated the unit values accurately, given the data available, systematic errors of measurement or systematic misreporting by the respondents could undermine these results. We thus would urge the users of this report to investigate independently the purchasing patterns of different categories of alcohol users, and the prices paid, before embarking on a minimum pricing strategy.

Appendix F: Competencies of the Provincial Government of the Western Cape in respect of alcohol pricing and taxation – A Legal Opinion

We (the legal firm Herbert Smith Freehills) have been requested to provide input regarding the feasibility, from a legal perspective, of the Western Cape Government imposing at a provincial level certain alcohol pricing mechanisms mooted in the Western Cape Government's Alcohol-related Harms Reduction Policy White Paper, 2017 (the **White Paper**). In particular, we understand that the Western Cape Government is considering implementing a provincial tax and/or imposing minimum unit pricing on alcohol. The purpose of this piece is to consider the legal regulatory framework within which this may be done.

Part 1 considers the general regulatory environment in respect of the liquor industry in South Africa, with a particular focus on the division of responsibilities between the national and provincial spheres of government. Against this background, consideration is given as to how minimum pricing might be accommodated in the current regulatory framework. Thereafter, Part 2 considers the powers of a province to impose a provincial tax, including the feasibility of doing so in a context where this runs contrary to the approach adopted by the national government.

General regulatory environment: the South African liquor industry

At a national level, the Liquor Act 59 of 2003 (**Liquor Act**) regulates the macro-manufacturing and distribution of liquor in South Africa through registration, while the micro-manufacturing and retail sale of liquor is regulated at a provincial level through a licensing regime. Production, marketing, export and import of wine and spirits is also regulated at the national level by the Wine and Spirit Control Act 47 of 1970 and the Liquor Products Act 60 of 1989.

The division of responsibilities between national and provincial spheres of government flows from their respective competencies as set out in the Constitution of the Republic of South Africa, 1996 (**Constitution**) and interpreted by the Constitutional Court in *Ex Parte President of the Republic of South Africa: In re Constitutionality of the Liquor Bill* 2000 (1) SA 732 (the **Liquor Bill case**). That case concerned an initial version of the Liquor Bill that had been passed by Parliament, but which the President had decided nevertheless to refer to the Constitutional Court for an assessment of its constitutionality. The President had decided to take this course of action due to certain reservations that he had regarding the Bill, and in particular the extent to which the regulatory framework that it proposed might unjustifiably impinge on 'liquor licensing' as a functional area of exclusive provincial legislative competence (as enshrined in Schedule 5A to the Constitution).

The Bill proposed, at a national level, to establish a framework for the registration of the manufacture, wholesale distribution and retail sale of liquor (although responsibility for registration of retail activities was assigned to provincial bodies, the Bill was nevertheless prescriptive in this regard, and the provinces were essentially mandated to fulfil a more administrative role in the system's implementation). The Court ultimately found that, while the national government's intervention was justified in (i) creating a national system of registration for manufacturers and wholesale distributors of liquor and (ii) prohibiting cross-holdings between the three tiers in the liquor trade (both matters which were considered to be essentially inter-provincial), it had not justified its intervention in regard to retail sales of liquor, whether by retailers or by manufacturers, nor for micro-manufacturers whose operations are essentially provincial.

As such, the Bill was amended and passed into law as the Liquor Act. The provinces duly passed their own legislation to deal with the licensing of micro-manufacturing and the retail sale of liquor.

National regulation

Under the Liquor Act, a person may not manufacture or distribute liquor unless registered and permitted to do so in terms of the provisions of the Liquor Act. Reasonable and justifiable conditions may be imposed on registrants, including in relation to black economic empowerment.

Sections 4 through 10 of the Liquor Act, which together form the basis for the contemplated regulation of the macro-manufacture and distribution of liquor at the national level, are entitled "National Liquor Policy". On 30 September 2016,[7] the national Department of Trade and Industry (**dti**) published in the *Government Gazette* the final version of a document entitled "Final Liquor Policy Paper: National Liquor Policy Review" (**Policy Review Paper**), which outlines various policy recommendations intended to amend the Liquor Act. However, these recommendations have not yet been implemented.

Currently, the National Liquor Authority (**NLA**) is a chief directorate within the dti to which the Minister of Trade and Industry delegated powers in terms of the Liquor Act to regulate the manufacturing and distribution of liquor, registration, education and enforcement. One of the proposals set out in the Policy Review Paper is to restructure the NLA to become the National Liquor Regulator (**NLR**). The current NLA is under-resourced to effectively perform monitoring and enforcements roles and the proposed restructure would, among other things, ensure that the new NLR is granted the resources to monitor and enforce not merely licensed traders, but also the trade of liquor holistically.

The Policy Review Paper also recognises the effectiveness of pricing mechanisms to reduce the harmful use of alcohol. The Policy recommends that pricing mechanisms be implemented through effective and efficient system for taxation together with adequate tax collection and enforcement. National Treasury is tasked with maintaining a reasonable and appropriate excise tax burden on alcoholic beverages. It is also recognised that there might be scope to further increase the excise duties on alcohol beverages, although this should be done mindful on the potential impact on illicit trade. No mention is made of minimum unit pricing.

Provincial regulation: Western Cape

In the Western Cape, the liquor industry is regulated at a provincial level through the Western Cape Liquor Act 4 of 2008 (as amended) (**WC Act**) and the Western Cape Liquor Regulations, 2011 (as amended) (**WC Regulations**).

The Western Cape Liquor Authority (**WCLA**), established in terms of section 2(1) of the WC Act, is the body tasked with the regulation of the retail sale and micro-manufacturing of liquor in the Western Cape. This is primarily implemented by way of a licensing regime.

The WCLA also has liquor inspectors who visit liquor licensed premises to monitor and enforce compliance with the provisions of WC Act, the WC Regulations, and liquor license conditions.

Under the licensing regime in the Western Cape, it is competent for the WCLA to impose conditions on the sale of liquor that relate to, among other things: the location(s) at which the liquor may be sold and/or consumed; the manner of delivery and storage; the acquisition of a financial interest in or appointment to the management of a licensed business; alteration to the premises of a licensed

[7] See GN 1208 in GG 40321.

business; sale to children (minimum age); trading hours; and the keeping of records and restrictions on quantities sold.[8]

Minimum unit pricing

We understand that one of the pricing mechanisms being considered by the Western Cape Government is minimum unit pricing, as set out in its White Paper.[9] This raises questions as to how minimum pricing might be accommodated in the current regulatory framework; in particular, would prescription of minimum prices fall within the competence of the national or provincial government?

Having regard to the current regulatory framework, matters relating to the retail sale of liquor are currently addressed at a provincial level only. Since minimum unit pricing would be imposed at the point of retail, it may appear appropriate on the face of it for such matters to be regulated at the provincial level. However, the assessment requires a greater degree of nuance.

As has been discussed above, provinces have exclusive legislative competence in relation to 'liquor licensing' – and it is this functional area of legislative competence to which the WC Act and Regulations give effect. In interpreting the ambit of this area of competence, the Constitutional Court in the Liquor Bill case recognised that liquor licensing ordinarily entails the competent authority giving permission to someone to do something with regard to liquor that would otherwise be unlawful (usually the sale of liquor at specified premises).[10] It was however also observed that the term 'liquor licences' in its natural signification encompasses not only the grant or refusal of the permission concerned, but also the power to impose conditions pertinent to that permission, as well as the collection of revenue that might arise from or be attached to its grant.[11]

That being said, this competence must be read against the background of the national government's concurrent legislative power in respect of the functional areas of 'trade' and 'industrial promotion' (as set out in Schedule 4A to the Constitution). Furthermore, even if a matter properly falls within a functional area of exclusive provincial legislative competence, the national government may intervene in that area if doing so is necessary to, among other things, maintain economic unity.[12] And, as the Constitutional Court has observed, the South African constitutional structure is one in which there is to be a single economy and in which all levels of government are to co-operate with one another. In the context of 'trade', economic unity was therefore held to mean the oneness, as opposed to the fragmentation, of the national economy (albeit in that case with regard to the regulation of inter-provincial, as opposed to intra-provincial, trade).[13]

As such, consideration as to whether the imposition of minimum unit pricing falls within a province's exclusive legislative competence therefore requires an assessment –

> First, as to whether pricing restrictions could legitimately fall within the scope of what is meant by 'liquor licensing';
>
> Second, if it does, whether it would nevertheless be in the interests of maintaining (national) economic unity for this to be regulated at a national level; and

[8] Sections 49 to 61 of the WC Act.
[9] Second paragraph, page 32 of the White Paper.
[10] The Liquor Bill case (*supra*), paragraph 56.
[11] *Ibid*.
[12] Section 44(2) of the Constitution.
[13] The Liquor Bill case (supra), paragraph 75.

Third, relatedly, whether such a pricing mechanism would more appropriately fall within the meaning of 'trade' or 'industrial promotion' (or indeed any other area of concurrent national and provincial legislative competence).

Without conducting a detailed assessment of these issues – which would likely require greater specificity on the manner in which minimum unit pricing is proposed to be introduced – it seems on the face of it that there would be strong arguments for this issue to be regulated at a national, rather than provincial, level. This seems to be recognised in the White Paper, which includes in its recommendations to "*[l]obby national government to increase the price of alcohol through increasing excise tax and/or introducing minimum unit pricing*".[14] In contrast to the proposal to explore an increase in excise tax at a provincial level (discussed below), there is no specific mention of the possibility of similarly imposing minimum unit pricing at a provincial level.

Provincial powers of taxation

Section 228 of the Constitution provides for the imposition of taxes by a provincial legislature, and reads as follows:

"(1) A provincial legislature may impose—

(a) taxes, levies and duties other than income tax, value-added tax, general sales tax, rates on property or customs duties; and

(b) flat-rate surcharges on any tax, levy or duty that is imposed by national legislation, other than on corporate income tax, value-added tax, rates on property or customs duties.

(2) The power of a provincial legislature to impose taxes, levies, duties and surcharges—

(a) may not be exercised in a way that materially and unreasonably prejudices national economic policies, economic activities across provincial boundaries, or the national mobility of goods, services, capital or labour; and

(b) must be regulated in terms of an Act of Parliament, which may be enacted only after any recommendations of the Financial and Fiscal Commission have been considered."

[14] Page 31 of the White Paper.

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