The impact of the Health Promotion Levy on the price of fruit juices in South Africa: An approach using shop-level prices

A Research Dissertation

Presented to

The Graduate School of Business

University of Cape Town

In partial fulfilment

of the requirements for the degree

Master of Business Administration

Submitted by:

Lisa Clarke

Supervisor:

Dr. Grieve Chelwa

Co-Supervision:

Professor Corne Van Walbeek

December 2019

PLAGIARISM DECLARATION

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.

2. I have used a recognised convention for citation and referencing. Each contribution to, and quotation in this report from, the work(s) of other people, has been attributed and has been cited and referenced.

3. This dissertation is my own work.

4. I have not allowed, and will not allow anyone to copy my work with the intention of passing it off as his or her own work.

5. I acknowledge that copying someone else's assignment or essay, or part of it, is wrong, and I declare that this is my own work.

Signature _____

Name: Lisa Clarke

Student Number: CLRLIS004

ACKNOWLEDGEMENTS

Firstly, I would like to thank my supervisor, Dr. Grieve Chelwa, for his guidance, patience and encouragement throughout the year. Both his deep passion for economics and his positive outlook on life is inspiring. Throughout the process, he highlighted the importance of learning new skills and enjoying the process and this positivity was highly motivating.

I am extremely grateful to Micheal Kofi Boachie of the Department of Economics at the University of Cape Town who taught me how to use Stata. He was very accommodating and patient and ensured that I was both comfortable and confident in using the programme to conduct my analysis.

I am extremely grateful to Professor Corne' Van Walbeek, of the School of Economics at the University of Cape Town, who took the time out of his busy schedule to provide direction for the research methodology and insight into the findings of the study. His vast experience, excitement, and passion, are very inspiring.

I am thankful to my Chief Executive Officer for granting me the permission to use data owned by my organisation and to Cindy Hunlun, a colleague, who patiently answered all my questions regarding sugar-sweetened beverage tax and fruit juice legislation and provided continued support throughout the process.

Finally, I would like to thank my partner, my family and my friends, for providing continued encouragement and support throughout the course.

ABSTRACT

Overconsumption of sugar results in weight gain and increased risk for the development of non-communicable diseases. Obesity levels in South Africa have increased significantly and are the highest recorded in sub-Saharan Africa. Non-communicable diseases result in large healthcare costs and these have serious implications for the economy. Individuals and families of sufferers are impacted by increased household expenditure, as a result of medical expenses, and losses in income. Many countries are therefore intervening by introducing taxes on sugar-sweetened beverages in order to improve public health. These taxes are cost-effective solutions which help to raise prices in order to reduce consumption of high sugar beverages. On 1 April 2018, South Africa introduced the Health Promotion Levy, a tax targeted at the sugar content of sugar-sweetened beverages at a rate of 0.021 ZAR (0.0014 USD equivalent) per gram of sugar over a tax-exempt threshold of 4g grams of sugar per 100mls. Drawing on hundreds of thousands of observations from store-level scanner data which includes prices of fruit juices in two of South Africa's three largest retailer groups between April 2017 and March 2019, this study examines the change in prices of both taxed and tax-exempt, fruit juices in South Africa after the introduction of the levy. Statistically significant increases in prices of taxed fruit juices and null price increases of tax-exempt fruit juices were found. Equally there was also a significant increase in the number of tax-exempt fruit juices available for sale in the market after the introduction of the levy. This suggests that sugar-sweetened beverage producers responded to the tax by increasing the number of tax-exempt products sold in the market. Further, evidence of under-shifting of the tax on taxed fruit drinks and nectars with larger pass-through taking place on smaller packaging sizes (500mls and less) was revealed. The findings of this study are consistent with the literature on the impacts of sugar taxes on sugar-sweetened beverages.

CONTENTS

List of Tables

List of Figures

Chapter 1: INTRODUCTION

1.1: Research Area and Problem

Globally, non-communicable diseases kill approximately thirty six million people per year (Basu et al., 2014). Physical inactivity and unhealthy diets are driving the increase in diabetes, heart diseases, strokes and cancer (Basu et al., 2014; Olivier, 2017). The prevalence of overweight or obese children in Africa has increased by 96 percent from 1990 to 2014 (World Health Organization, 2018) and South Africa has been ranked as the most obese country in sub-Saharan Africa (National Treasury, 2016). Increased sugar consumption leads to weight gain and increases the risk of obesity and non-communicable diseases (World Health Organization, 2014). There are various interventions that a government can implement in order to improve public health: tax-induced price increases is identified as one cost-effective solution (Sacks, Veerman, Moodie, & Swinburn, 2011). Therefore, to set out to curb obesity and non-communicable disease in the country, South Africa introduced the Health Promotion Levy, a tax on sugar-sweetened beverages, on 1 April 2018.

1.2: Significance of the Research

Whether or not sugar-sweetened beverage taxes are deemed successful depends on the impact of the tax on purchases of both taxed, and tax-exempt, products and the amount of government revenue raised as a result of the tax. Sugar-sweetened beverage taxes in other countries have resulted in reductions of sugar-sweetened beverage purchases with declines as large as 22 percent in Catalonia (Castelló & Casasnovas, 2019) and Chile (Nakamura et al., 2018) and 12 percent in Mexico (National Treasury, 2016). The decline in sugar-sweetened beverage purchases coincides with increased purchases of tax exempt, healthier beverages, and this substitution has had positive implications for public health. For example, sugar-sweetened beverage tax in Barbados, Berkeley, Philadelphia, and Mexico, have all resulted in increased purchases of bottled water (Alvarado et al., 2019; Cawley, Frisvold, Hill, & Jones, 2018; Colchero, Molina, & Guerrero-López, 2017; Falbe et al., 2016; Zhong, Auchincloss, Lee, & Kanter, 2018).

However, from a policy perspective, the degree to which prices of sugar-sweetened beverages change after the introduction of a sugar-sweetened beverage tax, is key. If there is no noticeable increase in price, as a result of an excise tax, it is unlikely that government will be successful in reducing the consumption of these beverages. The degree to which prices adjust to the tax

also affect whether producers, consumers, or both parties, are burdened by the tax (Linegar & Van Walbeek, 2015). Given the importance of pass-through from a policy perspective, the degree to which prices adjust to the tax, forms a pivotal element of this dissertation.

Sugar-sweetened beverage tax is a recent focus of study and as a result, the analysis of sugar-sweetened beverage tax outcomes globally, is fairly limited. Historically, most countries have introduced a tax based on either the volume or the sugar content of the sugar-sweetened beverage, however recently, more countries are introducing a tiered tax structure which taxes high sugar and low sugar beverages, differently. Together with the United Kingdom, South Africa is one of the more recent countries to introduce a tax including a tax-exempt threshold for beverages with a lower sugar content. This development provides a unique opportunity for analysis. I have had access to a large administrative dataset including variables which are unique to previous studies in South Africa. This research therefore seeks to contribute to improving our understanding of the implications of sugar-sweetened beverage taxes on pricing, and in doing so, this research will add to an emerging thread of research on sugar-sweetened beverage taxes, globally.

1.3: Purpose of Research

The main aim of this study is to examine the impact of the sugar-sweetened beverage tax on sugar-sweetened beverage prices in South Africa and specifically, the degree of pricing response to the tax. The National Strategy for the Prevention and Control of Obesity aims to reduce obesity prevalence by 10 per cent by 2020 in South Africa (National Treasury, 2016). However, price affects the quantity demanded and ultimately the consumption of sugar-sweetened beverages in the country. The magnitude of price change as a result of the tax, will therefore help to inform policy makers regarding the pricing implications of the levy on the outcomes on obesity.

1.4: Research Questions and Scope

The focus of this research is to determine the degree of response of retailer prices to the levy and the scope is limited to fruit juices in the formal retail environment in South Africa. The study focuses on fruit juices because I have not had access to data for other sugar-sweetened beverage categories. The data utilised includes sales from two of South Africa's three largest retailers which together, contribute a 68 percent share of consumers' most preferred places to shop in South Africa in 2018 ("South Africa's most …," 2018). Only one published study analysing the pricing response to the Health Promotion Levy exists in South Africa (Stacey et

al., 2019). This research differs in that the main focus is on fruit juices, while the other study focused on carbonated soft drinks. Second, I use store-level scanner data, whereas Stacey et al. (2019) used Consumer Price Index data to conduct their study.

Primary Research question

What is the pass-through rate of the Health Promotion Levy to consumer prices of fruit juices in formal retail South Africa?

The following research sub-questions were included in the study in order to assess whether the findings of the global sugar-sweetened beverage taxation studies are evident in a South African context.

Sub question 1.

Is there a difference in the change in beverage price following the introduction of the Health Promotion Levy among taxed, and tax-exempt, fruit juices?

An understanding of the difference in magnitude of price changes across taxed and tax-exempt fruit juices will help inform policy makers about changes in the cost of consumption and subsequent substitution between products.

Sub question 2.

Since the introduction of the Health Promotion Levy, has there been a significant change in the number of taxed and tax-exempt fruit juices sold in retail?

Product development and reformulation, outside of normal business operations, results in increased development, marketing, new packaging, and label costs, for producers (Allen et al., 2015). Understanding the change in product portfolio within stores will help inform policy makers regarding any additional tax burden on producers. The availability of tax and tax-exempt products influences substitution between these products, and therefore will provide valuable information for policy makers.

Sub question 3.

Is there a difference in the change in beverage pricing following the introduction of the Health Promotion Levy among different packaging sizes?

Understanding the difference in magnitude of price changes and the cost of consumption of different packaging sizes, will help to highlight any potential for substitution between smaller

and larger packaging sizes, and therefore indicate any relevant implications for total sugar consumed.

Sub question 4.

Does pass-through differ across consumer-branded or private label fruit juices?

Understanding the differentials in pass-through across consumer-branded or private label products will help to inform producers about retailers' pricing responses on own, versus supplier, brands.

Sub question 5.

Does pass-through differ across baseline pricing segments of fruit juice i.e. discount, average, or premium priced, brands?

Understanding the differentials in pass-through across differently priced brands helps to inform substitution between product types and brands and informs arguments against the regressive nature of sugar-sweetened beverage taxes. Findings will also help to inform both producer and retailer pricing strategies.

Sub question 6.

Does pass-through differ across different retail channels for fruit juice?

Understanding the differentials in pass-through across different retailer channels will help to inform the relative consumer tax burden of buyers in the different channels, and to inform pricing strategies for fruit juice producers and retailers.

Sub question 7.

Does pass-through differ across different regions of South Africa for fruit juice?

The Health Promotion Levy is a national tax, however understanding pass-through across different provinces is important in understanding the consumer burden of the tax in different provinces.

1.5: Research Assumptions

This study assumes that the retailers' electronic point-of-sale system accurately reflected all fruit juice sales in South Africa.

1.6: Research Ethics

The research did not involve any human participants. Permission for the use of the secondary dataset in the study was obtained from my employer whose name, for obvious reasons, is confidential. The retailers from whom my workplace purchased the data, and the brands included in the dataset, are also anonymous to protect their confidentiality. A *Commerce Faculty Ethics in Research* application form has been submitted to obtain ethical clearance as per University of Cape Town procedures.

Chapter 2: BACKGROUND

2.1: Understanding Sin Taxes

Sin taxes have been borne out of the basic economic theory of correcting internalities and externalities. Internalities refer to the unintentional harm to oneself, as a result of the consumption of a particular product, and externalities, in the context of this study, refer to social harms which impact other individuals, communities and families as a result of this consumption. Pigou (1920) found that if a good has harmful effects that are not considered by its consumers, then in an unregulated market, people will consume too much of it. Researchers have found evidence of harmful implications surrounding the use and consumption of products such as cigarettes and alcohol. For example, researchers have found evidence to support that cigarette smoking leads to impaired immune function and type II diabetes (Warren, Alberg, Kraft, & Cummings, 2014). Furthermore, these authors have found that non-smokers are also affected by cigarette smoking with second hand smoke negatively impacting non-smoker's respiratory, cardiovascular, aerodigestive, and reproductive, systems. The excessive intake of alcohol is associated with premature death, increased disease, and injury (Bouchery, Harwood, Sacks, Simon, & Brewer, 2011). Non-alcohol drinkers are impacted by other's excessive consumption of alcohol in the form of drunk driving fatalities, alcohol-induced violence, property damage, and a decline in employee productivity (Bouchery et al., 2011). However, consumers continue to consume harmful products. Consumers tend to value short term gratification disproportionately more than they consider the costs of long-term consequences of the consumption of these products (Heutel, 2011). Consumers are also at times unaware of the harmful implications to themselves and others due to a lack of education or uncertainty, about the consequences of consumption (Allcott, Lockwood, & Taubinsky, 2019a). In order to try and reduce these social harms and costs to both individuals and society, governments across the world have intervened and introduced sin taxes. Sin taxes reduce social harms by increasing the cost of manufacturing, distributing, retailing, and ultimately consuming harmful products (Wright, Smith, & Hellowell, 2017).

2.2: The Economic Theory Supporting a Sin Tax

Sin taxes increase the cost of production of taxed products due to producer tax payments, potential declines in sales volumes, declines in production, and decreased efficiency in production (Barzel, 1976) ultimately decreasing producer profitability. In response to the tax

and to minimise losses, producers can increase the prices of taxed products and/or reformulate taxed products in order to reduce their tax liability.

2.3: Different Types of Tax

Different products can be subject to different types of tax. S*pecific excise* taxes are levied against a specific quantity whereas *ad valorem excise* taxes are levied against a particular proportion of value. Furthermore, specific excise taxes can be levied, based on the volume of the product or the quantity of a named ingredient within the product. From an economic and public health perspective, it has been argued that an ingredient-based excise tax is more effective than a volume-based tax because it encourages manufacturers to reformulate products (Allcott, Lockwood, & Taubinsky, 2019b). It also raises the relative price of products containing higher levels of the taxed ingredient, resulting in substitution towards products containing *less* of the taxed ingredient (Blecher, 2015). However, Francis, Marron and Rueben (2016) found that volume-based taxes tend to raise government revenue more efficiently.

2.4: Results of Sin Taxes

As economic theory attests, sin taxes generally result in increased prices and decreased purchases of the harmful, taxed product. However, the degree of pricing power in the market impacts the ability of producers to raise their prices. For example, small, medium, and micro, enterprise (SMME) convenience stores in the Cape metropole (South Africa) contain minimal pricing power due to tough competition, and therefore have limited ability to raise their prices. As a result, an increase in tobacco excise taxes decreased their profitability (Salie et al., 2014). Decreased producer profitability, because of a sin tax, often leads to the emergence of illegal trade. Vellios, Van Walbeek, and Ross (2019) estimated that illicit trade for cigarettes already accounted for up to 35 percent of the total cigarette market in South Africa in 2017.

To maintain profitability levels, producers often reformulate products, introduce new tax-exempt products, or re-allocate new product development and advertising expenditure towards tax-exempt or lower taxed products. For example, as a result of an alcohol dose tax in South Africa, South African Breweries increased their advertising on Castle Lite, a marketed lower-alcohol beer, resulting in a 19 percent growth in Castle Lite's advertising share from 1997 to 2013 (Blecher, 2015).

A common argument made against sin taxes is that they result in larger financial impacts for lower-income consumers (Allcott et al., 2019a). However, considering that these consumers are generally more price sensitive, researchers argue that they should receive the largest health benefits as a result of larger declines in consumption of the taxed product. Furthermore, the additional revenue generated by the government as a result of the sin tax could be used to deliver improved public services, which ultimately would have the effect of benefitting lower income consumers disproportionately more than higher income consumers (Sassi et al., 2018).

Other unintentional yet potentially harmful consequences of sin taxes include the re-allocation of household budgets towards harmful products at the expense of other daily necessities (Black & Mohamed, 2006) and substitution to cheaper and potentially more harmful products. McLoughlin, Little, Mazok, Parry and London (2013) found that *papsak*, a cheaper and lower quality wine sold in foil bags in South Africa, is more strongly associated with problem drinking than other more expensive alcoholic beverages in the Western Cape and therefore, substitution towards *papsak* as a result of alcohol excise tax increases would increase social costs.

2.5: Why Tax Sugar and Sugar-sweetened Beverages in Particular?

Increased sugar consumption leads to weight gain (World Health Organization, 2014) and increases the risk of obesity and non-communicable diseases such as heart diseases, type 2 diabetes, and cancer (National Treasury, 2016). In 2015, South Africa was ranked as the country with the second highest number of deaths attributed to sugar consumption (Retief, 2015) with over 260 000 South Africans dying as a result of a non-communicable disease in 2016 (Stats SA, 2018). Sugar-related diseases result in considerable health care costs and these costs divert governmental funds away from sectors that help to boost the economy. The economy also suffers from a loss of productivity and efficiency as a result of employee mortality and morbidity (Manyema, Veerman, Tugendhaft, Labadarios, & Hofman, 2016). In 2015, the costs associated with productivity losses as a result of ill health accounted for 6.7 percent of South Africa's gross domestic product, with estimates that this contribution would increase to 7 percent by 2030 (Rasmussen, Sweeny, & Sheehan, 2017). Families of non-communicable disease sufferers also experience reduced household income due to lost wages and medical expenses (Stacey, 2017). Therefore, non-communicable diseases, the result of over-consumption of sugar, produce both financial and social costs for individuals, families, communities, and ultimately, the economy.

The consumption of sugar-sweetened beverages has dramatically increased in urban areas in South Africa with these beverages being the second most commonly bought street food item in 2015 (Ronquest-Ross, Vink, & Sigge, 2015). The rise in consumption is partly due to the wide availability, the regular advertising, and the increasing affordability, of these beverages (Blecher, Liber, Drope, Nguyen, & Stoklosa, 2017). However, sugar-sweetened beverages contain fluid calories which are generally consumed quickly, do not provide consumers with the same feeling of 'fullness' as opposed to the consumption of solid calories, and do not have the same nutritional value as solid calories (Stacey, Tugendhaft, & Hofman, 2017). Therefore, consumption of these beverages leads to excess calorie intake. Other harmful implications include tooth decay (Sheiham, 2001) and raised blood pressure after consumption (Malik & Hu, 2011). A sugar-sweetened beverage tax could raise the price of these beverages and decrease the quantity demanded with researchers finding sufficient evidence that a reduction in sugar-sweetened beverage consumption would result in decreased risk of obesity (Hu, 2013). A tax could also raise awareness of the high sugar content of these beverages in order to educate and persuade consumers to purchase healthier, untaxed beverages (Roache & Gostin, 2017).

2.6: The World Health Organization

The World Health Organization recommends that consumers limit their sugar intake to 12 teaspoons of sugar per day to prevent obesity. However, they advise that a sugar-sweetened beverage contains up to 11 teaspoons of sugar, on average, and therefore it recommends limiting the consumption of sugar-sweetened beverages (Department of Health South Africa, 2018). The organisation highlights negative implications of obesity such as non-communicable diseases and the negative psychological effects associated with weight gain such as low self-esteem, depression, and social isolation (World Health Organization, 2019). The organisation therefore supports sugar-sweetened beverage taxes and recommends that countries introduce a sugar-sweetened beverage tax in order to address high obesity levels. It suggests that revenue raised from the tax could fund programmes to further promote healthy lifestyles, particularly among younger and lower income consumers (World Health Organization, 2017). It recommends tax as an effective tool to decrease sugar consumption because it asserts that price is an important factor in the selection of food. It also identifies challenges in the effectiveness of other tools such as nutritional labelling and education, because it is believed that most behaviours and food preferences are developed during childhood and therefore attempting to adjust behaviour later in life is difficult to achieve (World Health Organization, 2014).

2.7: Which Countries Have Introduced a Sugar-sweetened Beverage Tax?

More than thirty five locations (Colchero, J., Popkin, & Ng, 2017) and twenty countries (Lloyd & MacLaren, 2019) have introduced a sugar-sweetened beverage tax. The most recent locations include San Francisco, South Africa, the United Kingdom, Ireland and Peru (Lee, 2018) with most locations introducing volume-based excise taxes or similar with the exception of Chile, and the states of Maine and Ohio in the United States, where taxes are levied as *ad valorem* taxes (Griffith, Connell, Smith, & Stroud, 2019). Certain locations have introduced taxes with a banded structure which differentiates the tax rate into different tiers according to the sugar content of the beverage. This ultimately provides an incentive for manufacturers to reduce their tax liability by reformulating products to below the tax threshold. The United Kingdom, Catalonia and Portugal have introduced a banded tax.

2.8: What Are the Results of a Sugar-sweetened Beverage Tax?

Across various different types of sugar-sweetened beverage taxes introduced, and taxed jurisdictions reviewed, sugar-sweetened beverage taxes have resulted in price increases of sugar-sweetened beverages by varying degrees and declines in the purchase and consumption of these taxed beverages. Various researchers have found substitution effects towards certain non-taxed beverages such as water, fruit juice, dairy-based beverages and tea (Alvarado et al., 2019; Basu et al., 2014; Cawley, Frisvold, et al., 2018; Colchero, Molina, et al., 2017; Falbe et al., 2016; Finkelstein et al., 2013; Zhong et al., 2018). The substitution towards tax-exempt beverages impacts total calorie consumption and the effectiveness of the tax. For example, a study in the United States found that substitution by youths towards whole milk beverages offset the total reduction in sugar-sweetened beverage calories consumed as a result of the sugar-sweetened beverage tax (Fletcher, Frisvold, & Tefft, 2010). Other researchers have found evidence of substitution towards high calorie foods such as chocolate (Edwards, 2011) and pizza (Duffey et al., 2010) and to products which produce different social harms, such as alcohol and lager, beer, cider, and wine, in particular (Quirmbach, Cornelsen, Jebb, Marteau, & Smith, 2018). Furthermore, researchers have found evidence of substitution towards less environmentally sustainable products with higher greenhouse gas emissions such as coffee (Briggs, Kehlbacher, Tiffin, & Scarborough, 2016) and to products sweetened with non-nutritive sweeteners, which are also associated with increased risk to develop obesity, metabolic syndrome, and type 2 diabetes (Pepino, 2015). Therefore, substitution effects should

be accounted for to accurately assess the effectiveness of a sugar-sweetened beverage tax in combatting obesity and minimising social harms.

To reduce the tax burden, a common practice by sugar-sweetened beverage producers is to reduce packaging sizes but maintain prices in order to increase their gross margin and avoid a price increase for price sensitive consumers. However, consumers are becoming more educated, tend to notice this 'shrinkflation' more, and are more likely to spread the word to others. Furthermore, once these consumers are aware of 'shrinkflation', they tend to think less favourably of the product, brand, and retailer (Kachersky, 2011). Therefore, the 'shrinkflation' strategy poses additional risks to brand and retailer reputation and revenue streams in the long-term.

2.9: The Health Promotion Levy in South Africa

2.9.1: The introduction of the Health Promotion Levy

The South African National Department of Health supported the benefits of a sugar-sweetened beverage tax as a means of achieving its objective to reduce obesity and non-communicable disease prevalence in South Africa (National Treasury, 2016). The department released a policy paper outlining the proposed tax. Pravin Gordhan, former minister for finance, announced the sugar-sweetened beverage tax in his 2016 budget speech (Olivier, 2017). After extensive legal consultations, the Health Promotion Levy was legislated through the Rates and Monetary Amounts and Amendment of Revenue Laws Act, 2017 - Act No. 14 of 2017 with effect from 1 April 2018 (South African Revenue Services, 2019).

Economic theory suggests that a sugar-sweetened beverage tax should raise prices of sugar-sweetened beverages and researchers have found that price is the most important factor considered when selecting food items in South Africa (Ronquest-Ross et al., 2015). This would therefore suggest that tax-induced price increases of high sugar beverages would be an effective tool in addressing overconsumption of sugar in South Africa. However, there was notable opposition to the introduction of the levy by the sugar-sweetened beverage industry. Industry argued that the levy would result in job losses (with predictions of 60 000 jobs lost) (Benade & Essop, 2017) in a country with high unemployment as well as declines in gross domestic product. Further opposition included a lack of trust in the effectiveness of sugar-sweetened beverage taxes; sugar-sweetened beverage taxes being labelled as 'regressive'; and the Beverage Association calling it 'discriminatory' (Morton, 2016). Many arguments were also put forward about sugar not being the only cause of obesity (Olivier, 2017). The objectives of

the National Treasury were also questioned, with the industry suggesting that the levy was introduced to generate additional revenue for the state. Opposition, and extensive legal consultation, resulted in a one year delay in the implementation of the levy.

Fooks, Williams, Box, and Sacks (2019) recently conducted a study which analysed citations by industry representatives to South Africa's National Treasury during the consultation process and found evidence of inaccurate reporting with false reference to findings in peer reviewed journals, important qualifying information omitted from citations and "hyperbolic accounting" used to inflate the economic impact of the tax. The American Chamber of Commerce in South Africa, Coca-Cola, and the Beverage Association of South Africa, were named as having used one or more of these techniques to support false claims.

2.9.2: The Health Promotion Levy specifications

The tax amount is set by National Treasury and is reviewed on an annual basis. The Health Promotion Levy is a national, ingredient-based excise tax. In 2018, the levy was set at 0.021 ZAR (0.0014 USD equivalent) per gram of sugar over a threshold of 4g of sugar per 100mls for all sugar-sweetened beverages in South Africa. This roughly equated to a 10 percent tax (Stacey et al., 2017). Most researchers suggest that a tax of at least 20 percent would be most effective in reducing obesity (Wennlo, 2018) and therefore the National Treasury continues to face considerable pressure to increase the levy, despite an increase to 0.0221 ZAR per gram over the 4g threshold in April 2019 to account for inflation. Taxed beverages contain added calorific sweeteners such as sucrose, high-fructose corn syrup, or fruit juice concentrate, and include soft drinks, fruit drinks, sports and energy drinks, vitamin water drinks, sweetened iced tea, and lemonade (Stacey et al., 2017). Products exempt from the tax include water, unsweetened milk products, and 100% fruit juice. Sugar-sweetened beverage manufacturers are now required to run sugar tests on their products through the South African National Accreditation System (SANAS) or the International Laboratory Accreditation Cooperation (ILAC) accredited testing facilities, and to pay the relevant tax to the South African Revenue Services (South African Revenue Services, 2019). In 2018, the levy raised almost R2.5 billion in government revenue (National Treasury, 2019) with the country's ninth biggest fruit juice[1] manufacturer in retail paying 7 percent of their annual revenue towards the levy.

[1] Fruit juice includes short and long-life fruit juice, liquid concentrates, and powdered fruit juices.

2.10: Non-alcoholic Beverage Category in Retail South Africa

The non-alcoholic beverage market in formal retail South Africa consists of over 227 manufacturers and the largest manufacturer owned a revenue market share of 46 percent in 2018 (Nielsen, 2019). By utilising Nielsen data, the Herfindahl-Hirschman Index[2] as depicted in Table 1 has been estimated and the finding is that the category is moderately concentrated according to the Competition Commission's classification of marketplace concentration (Ngwema, 2018) with a Herfindahl-Hirschman index of 2 298. Market leaders of the carbonated soft drinks and short life[3] dairy mix categories also contain considerable pricing power. Manyema et al. (2014) determined an own price elasticity of demand of -1.3 for sugar-sweetened beverages in South Africa, indicating that a 10 percent increase in the price of sugar-sweetened beverages would result in a 13 percent decline in their consumption. Furthermore, Stacey et al. (2017) found that carbonated soft drinks are price elastic and that fruit juices are price inelastic with price elasticities of -1.18 and -0.44 in South Africa, respectively. Considering that both carbonated soft drinks and fruit juices markets are highly concentrated, and assuming identical pass-through for both beverage categories, one would expect larger reductions in the purchases of soft drinks as a result of the tax. This is as a result of the larger price elasticity of demand of carbonated soft drinks, and the higher market share, with carbonated soft drinks accounting for 39 percent of 2018 non-alcoholic beverage revenues in retail South Africa (Nielsen, 2019). Therefore, it is expected that price increases following a sugar-sweetened beverage tax would produce better results, from a public health point of view, for carbonated soft drinks in contrast to fruit juices.

[2] The Herfindahl-Hirschman Index is a measure commonly used to determine levels of market concentration. It is calculated by determining the market share of each manufacturer in the category, squaring their market share, and summing the results from each manufacturer. The index can range from zero to 10,000.

[3] 'Short life' refers to products which, on average, have a shelf life of up to 30 days and are therefore merchandised in the fridge in retail outlets. Conversely, long life products, on average, have a shelf life of up to six months and therefore do not require chilling in a fridge.

Table 1: Market Concentration of Non-Alcoholic Beverage Categories

South African Retail (Grocery & Convenience)	Share	2018 Revenue	Annual Growth	Herfindahl-Hirschman Index		Market leader share
Non-alcoholic beverages	**100%**	**R32 177 200 378**	**7.0%**	**2 298**	**Moderately concentrated**	**Market Leader - 46%**
Carbonated Soft Drinks	39%	R12 707 451 246	6.9%	8 292	Highly concentrated	Market Leader - 91%
Drinking Yoghurts	16%	R5 081 133 453	4.9%	2 127	Moderately concentrated	Market Leader - 39%
Energy Drinks	8%	R2 717 855 500	6.8%	2 578	Highly concentrated	Market Leader - 40%
Long Life Fruit Juice	8%	R2 717 540 541	13.7%	3 153	Highly concentrated	Market Leader - 53%
Mineral Water	8%	R2 443 437 579	10.9%	3 779	Highly concentrated	Market Leader - 48%
Short Life fruit juice	6%	R1 919 565 251	5.6%	2 608	Highly concentrated	Market Leader - 48%
Liquid Concentrates	6%	R1 803 649 107	4.9%	3 553	Highly concentrated	Market Leader - 53%
Short Life Dairy Mix	3%	R945 013 370	-0.1%	8 327	Highly concentrated	Market Leader - 91%
Sports drinks	3%	R827 739 870	13.7%	4 956	Highly concentrated	Market Leader - 55%
Flavoured Milk	2%	R566 168 752	10.2%	4 173	Highly concentrated	Market Leader - 48%
Iced Tea	1%	R427 313 578	-6.6%	2 477	Moderately concentrated	Market Leader - 43%
Powdered fruit juice	0%	R20 332 131	15.6%	3 215	Highly concentrated	Market Leader - 51%

Notes: Table 1 shows the total revenue and annual revenue growth for the period March 2018 to February 2019 for non-alcoholic beverages in formal retail South Africa. It also shows the Herfindahl-Hirschman Index and manufacturer market share for each non-alcoholic beverage category.

Source: Nielsen, 2019

Chapter 3: LITERATURE REVIEW

3.1: Introduction

Beverage taxes are a recent focus of research with Cawley, Frisvold et al. (2018) describing the taxes as being "nearly unknown 10 years ago." Despite limited historical literature, there has been a rapid increase in research in the area of beverage taxes with at least twenty seven published studies on sugar-sweetened beverage taxes which encapsulate different countries, datasets, and methodologies (Griffith et al., 2019). In line with this upward trend, many scholars have analysed pass-through of sugar-sweetened beverage tax in order to primarily inform policymakers on the effectiveness of the tax in addressing over-consumption of sugar and secondly, to inform government revenue objectives (Castelló & Casasnovas, 2019). This chapter provides a brief summary of the literature, paying particular attention to estimates of pass-through for alcohol, cigarettes, and sugar-sweetened beverages.

3.2: Pass-through Definitions

The definition of pass-through is consistent across researchers who describe it as the degree to which prices of taxed products change after a tax is introduced (Bonnet & Réquillart, 2013; Falbe, Rojas, Grummon, & Madsen, 2015; Harding, Leibtag, & Lovenheim, 2012; Kenkel, 2005; Silver et al., 2017; Zhong et al., 2018). Espinosa and Evans (2013) describes the purpose of the pass-through co-efficient as that "which measures how much of the tax is passed onto consumers in the form of higher prices." (p. 156). The pass-through affects the net welfare gains and losses, and who bears the burden of the tax. Harding et al. (2012) explains that the burden of the tax in question can either be "passed forward" to consumers in terms of price increases or "passed backward" to suppliers in terms of increased costs of production, depending on the degree of pass-through (p. 170).

Whilst different researchers estimate pass-through across different taxed products, most researchers assume 100 percent pass-through to consumer prices when determining the impact of a sin tax on consumption (Andreyeva, Chaloupka, & Brownell, 2011; Etile & Sharma, 2015; Stacey et al., 2017). The literature refers to various variables that effect pass-through such as the "costs producers face" (Nakhimovsky et al., 2016, p. 2), "consumers' responsiveness to price change" (Nakhimovsky et al., 2016, p. 2), "relative elasticities of supply and demand" (Andreyeva et al., 2011, p. 414), "retailers' purchasing constraints" (Zhong et al., 2018, p. 32), "market competitiveness" (Kenkel, 2005, p. 273) and "the size of jurisdiction to which it

applies" (Griffith et al., 2019, p. 2). The literature further explains that pass-through is inversely related to demand (Russell & Van Walbeek, 2014) and the level of market competition (Linegar & Van Walbeek, 2015).

The literature cites several similar definitions of pass-through in different market structures with Bergman and Hansen (2012) detailing that "it is well-known that within a model with full competition, excise taxes (as well as ad valorem taxes) are fully passed on to prices leading to a one-for-one change in after tax prices" (p. 2). However, the literature suggests that in monopoly or oligopolistic markets with imperfect competition and convex demand curves (Bergman & Hansen, 2012), taxes can be over-shifted[4] with price increases greater than the total tax amount, and a larger consumer tax burden, or under-shifted[5] with price increases less than the total tax amount, and the tax burden shared by both the consumer and producer. An over-shift of tax would result in larger substitution and income effects leading to larger declines in both consumption and government revenue raised, with the opposite result true for an under-shift of tax (Andreyeva et al., 2011). Therefore, the degree of pass-through directly impacts the objectives of policy makers.

3.3: Pass-through Results

3.3.1: Pass-through of alcohol and cigarette taxes

Scholars have estimated pass-through for alcohol taxes, and these studies tend to find that alcohol taxes are generally over-shifted with price increases equating to more than the total tax amount. This over-shift results in a larger than expected consumer tax burden with higher profits generated by producers. The incidence of over-shift indicates that alcohol markets are fairly concentrated, and that manufacturers enjoy a degree of pricing power (Russell & Van Walbeek, 2014).

A study by Kenkel (2005), conducted in Alaska during 2002 and 2003 utilising pricing data collected through telephonic interviews with alcohol retailers, found that the alcohol tax was more than fully passed through to beer, wine, and spirit prices, with evidence of over-shift in both on-premises and off-premises, and that prices adjusted very quickly, within three months. These findings concur with a study conducted by Young and Bielinska-Kwapisz (2002), using

[4] A tax is referred to as over-shifted when the price increases of the taxed products equate to more than the total tax amount.

[5] A tax is referred to as under-shifted when the price increases of the taxed products equate to less than the total tax amount.

Consumer Price Index data, which concluded that there was an over-shift of beer, wine, and spirit prices, in the United States. A consistent conclusion for alcohol tax pass-through can be made in the South African market. Russell and Van Walbeek (2014), using Consumer Price Index data sourced from Statistics South Africa for the period of December 2001– May 2013, found that there was an over-shift of alcohol taxes with a R1 excise tax resulting in a R4.77 increase in beer prices. The study also estimated fully-shifted[6] tax for spirits with price increases equal to the total tax amount, and larger pass-through for smaller packaging sizes of alcoholic beverages (Russell & Van Walbeek, 2014) with price increases greater than the total tax amount.

Tobacco tax pass-through has been extensively researched with consistent findings to that of alcohol taxes with evidence of over-shifted tax. Sullivan and Dutkowsky (2012) utilised tax data from the American Chamber of Commerce Researchers Association Cost of Living Index and from the Tax Burden on Tobacco and found evidence of over-shifted tobacco tax with a US$1 increase in the state excise cigarette tax in the United States resulting in a US$1.10 – 1.14 increase in cigarette prices. Findings from a study conducted by Hanson and Sullivan (2009) using cigarette pricing data from retail establishments in Wisconsin, concur with Sullivan and Dutkowsky's findings with evidence of over-shifted tobacco excise tax on a US$1 tobacco increase.

Despite multiple researchers finding evidence of an over-shift of tobacco taxes in the United States (Barzel, 1976; Harris, 1987; Johnson, 1978) certain researchers find evidence of an under-shift of tobacco tax in other countries. Delipalla and O'Donnell (2001), using price data for twelve European countries over a 16 year period, and applying a reduced-form method which allowed for identification of market power and conduct, both found that there was an under-shift of *ad valorem* and *specific* taxes in a group of Northern European countries including Belgium, Denmark, Germany, Ireland, Netherlands, and the United Kingdom. Some researchers have argued that consumers try and avoid tobacco taxes by purchasing cigarettes from neighbouring, lower-taxed states or countries (DeCicca, Kenkel, & Liu, 2013). This creates additional pricing pressure on tobacco companies and retailers due to cheaper substitutes available to consumers and could explain lower pass-through estimates for states located near lower-taxed jurisdictions (Sullivan & Dutkowsky, 2012). Furthermore, lower pass-through estimates can be explained by the use of survey data to conduct pass-through

[6] A tax is referred to as fully-shifted when the price increases of the taxed products equate to the total tax amount.

analysis, whereby consumers report prices of products purchased in both the taxed and the near lower-taxed jurisdictions. These arguments are supported by findings from researchers which conclude lower pass-through in areas geographically located near lower taxed states in the United States (Harding et al., 2012; Sullivan & Dutkowsky, 2012).

Tobacco tax pass-through in the South African market is consistent with the United States, with evidence of an over-shift of tax. Linegar and Van Walbeek (2015), using Consumer Price Index data collected from Statistics South Africa, found that a R1 tobacco tax increase resulted in a R2.63 increase in real retail cigarette prices in South Africa. Consistent with the quick pricing adjustments in the United States, cigarette prices increased within one month of the tax changes in South Africa. The notably fast rate at which prices adjusted in the South African market could be explained by the dominance of one producer, after the merger of Rothmans and British American Tobacco in 1999, owning considerable pricing power in the market with a 95 percent market share.

3.3.2: Pass-through of sugar-sweetened beverage taxes

Despite the important implications of pass-through on health outcomes, the literature provides a wide range of pass-through estimates with evidence of sugar-sweetened beverage tax having an under-shift, over-shift, and fully-shift effect on consumer prices. In part, the heterogeneity in results could be explained by the different techniques and datasets used. Griffith et al. (2019) reviewed twenty seven studies and found that all studies which analysed the impact of a sugar-sweetened beverage tax on sugar-sweetened beverage prices, found evidence of increased consumer prices, with pass-through either full, or near-full, depending on what products and jurisdiction were analysed. Table 2 has been adapted from Griffith et al. (2019) and provides a summary of the available sugar-sweetened beverage tax pass-through literature, unpacking the different sources of data used, and methodologies applied. Most countries have introduced volume-based/specific sugar-sweetened beverage taxes and most studies have utilised store-level scanner data applying a 'difference-in-difference' approach[7]. In using this approach, researchers selected a neighbouring jurisdiction, which had similar demographics to the taxed jurisdiction but was sugar tax-exempt, and used this secondary jurisdiction as a control group

[7] A 'difference-in-difference' approach is a methodology used by researchers to determine causality between an independent and dependent variable. A control group, which excludes the independent variable, and test group, which includes the independent variable, are analysed and the results are compared so as to determine whether the existence of the independent variable impacts the outcome on the dependent variable.

in order to benchmark the results of the test/taxed jurisdiction. Upon investigation, there does not seem to be any significant difference in pass-through across the different types of tax.

Table 2: Sugar-sweetened beverage tax pass-through literature (Adapted from Griffith et al.)

Author	Year	Jurisdiction	Tax Type	Data				Methodology		Pass-through
				Store-level	Household-level	Survey	Collected prices	Before after comparison	Difference-in-differences	
Bahl et al.	2003	Ireland	Banded Specific			X		X		Partial
Bergman and Hansen	2012	Denmark	Specific			X		X		Over shifting
Colantuoni and Rojas	2015	Maine & Ohio	Ad Valorem	X					X	Full
Colchero et al.	2015	Mexico	Specific			X		X		Full
Falbe et al.	2015	Berkeley	Specific				X		X	Partial (low)
Berardi et al.	2016	Berkeley	Specific	X					X	Partial (high)
Alvarado et al.	2017	Barbados	Ad Valorem	X				X		Partial
Cawley and Frisvold	2017	Berkeley	Specific				X		X	Partial (low)
Rojas and Wang	2017	Berkeley	Specific	X					X	Partial (low)
	2017	Washington	Specific	X					X	Full
Silver et al.	2017	Berkeley	Specific	X					X	Partial (high)
Aguilar et al.	2018	Mexico	Specific		X			X		Full
Bollinger and Sexton	2018	Berkeley	Specific	X					X	Partial (low)
Capacci et al.	2018	France	Specific		X				X	Full
Castelló and López-Casasnovas	2018	Catalonia	Banded Specific	X				X		Full
Cawley et al.	2018	Philadelphia	Specific				X		X	Full
Cawley et al.	2018	Philadelphia	Specific				X		X	Partial to full
Cawley et al.	2018	Boulder	Banded Specific				X		X	Partial (high)
Etilé et al.	2018	France	Specific		X			X	X	Partial (low)
Leider	2018	Illinois	Specific	X					X	Over shifting
Seiler et al.	2018	Philadelphia	Specific	X					X	Full
Gonçalves and Pereira dos Santos	2019	Portugal	Banded Specific	X					X	Partial (high)
Stacey et al.	2019	South Africa	Banded Ingredient			X		X		Partial (high)

Notes: Table 2 shows a summary of the methodology and data utilised for each sugar-sweetened beverage tax study reviewed, and the resultant pass-through of the tax.

Source: Griffith et al. (2019)

Mexico is one of the first countries to have analysed the results of a sugar-sweetened beverage tax and the findings have been cited in most global pass-through reviewed studies (Basu & Madsen, 2017; Bollinger & Sexton, 2018; Stacey et al., 2019). To determine pass-through of the sugar-sweetened beverage tax in Mexico, Colchero et al. (2015) used prices from the National Institute of Statistics and Geography (INEGI), the entity which estimates the Consumer Price Index (CPI) of Mexico. A disadvantage of using CPI data is that it does not provide full product descriptions and therefore the researchers weighted the data using Nielsen purchase data to allow for more statistically accurate results. The researchers found heterogeneous results amongst carbonated and non-carbonated sugar-sweetened beverages with a pass-through of between 95 and 112 percent, and 53 and 74 percent, respectively. The higher pass-through for carbonated beverages was explained by higher market concentration levels, market share, and lower prices. Similarly, Grogger (2017) found evidence of an over-shift in tax on sodas in contrast to slight, if any, increase on prices of other taxed beverages in Mexico due to higher levels of market concentration for sodas.

Despite evidence of an over-shift of tax on carbonated soft drinks in Mexico, many researchers find evidence of an under-shift of tax for sugar-sweetened beverages as a whole, with under-shift potentially undermining the health benefits of a sugar-sweetened beverage tax. Cawley, Crain, et al. (2018), using hand collected pricing data from retail stores and restaurants, found evidence of an under-shift of tax on sugar-sweetened beverages in Colorado, US, with pass-through of 78.9 percent. Similarly, Cawley, Willage, and Frisvold (2018) estimated pass-through at the Philadelphia International Airport, by utilising prices from all stores in the airport, and found that there was an under-shift of sugar-sweetened beverage tax with pass-through of 93 percent. The study was however limited to only two brands, one location and one packaging size. Subsequently, in a more robust study, Cawley, Frisvold, et al. (2018) collected pricing data from stores on the posted shelf prices of 38 taxed, and 8 untaxed, products across a range of beverage types, manufacturers, and container sizes, and applied a 'difference-in-difference' approach to compare the change in stores in Philadelphia to comparison (or control) communities. They found evidence of tax fully-shifted with complete pass-through of 104 percent for all sugar-sweetened beverages. Other interesting findings from the study include lower pass-through for fruit juice at 73 percent.

Studies in California highlight consistent results with evidence of an under-shift of tax. By utilising Nielsen Scanner data which included weekly prices scanned at the store level and a 'difference-in-difference' design, Bollinger and Sexton (2018) estimated pass-through of 25

percent in national supermarket chain stores in Berkeley, California. Silver et al. (2017), using point-of sale scanner data and beverage prices from 26 Berkeley stores, concur with these findings of an under-shift tax, and estimate pass-through of 67 percent for all sugar-sweetened beverages, complete pass-through for sodas and energy drinks, but incomplete pass-through for other taxed beverages in Berkeley, California.

However, in contrast to other studies in the United States, Leider et al. (2018), using a similar 'difference-in-difference' design and store level prices, found evidence of an over-shift of tax with pass-through of 114 percent and 121 percent for sugar-sweetened and artificially-sweetened beverages, respectively in Cook County, Illinois.

Heterogeneous pass-through is also evident in European countries with an econometric analysis, using data from governmental reports, finding evidence of tax under-shifting in Ireland (Bahl, Bird, & Walker, 2003), a study using survey data found complete pass-through for soft drinks and tax under-shifting for fruit juices in France in 2012 (Capacci, Allais, Bonnet, & Mazzocchi, 2019); a study using prices collected from 'click-and-collect' stores where consumers are able to order groceries online and collect them via a drive-through, found evidence of an under-shift of tax for flavoured waters and fruit juices, but full pass-through for sodas in France (Berardi, Sevestre, Tepaut, & Vigneron, 2016) and a report by the European Competitiveness and Sustainable Industrial Policy Consortium (2014) cited over-shifted tax for soft drinks in Finland.

Although the majority of sugar-sweetened beverage tax pass-through studies are conducted in the United States, similar results are evident in the South African market. In a recent study (2018) conducted in South Africa using Consumer Price Index data, Stacey et al. (2019) found evidence of under-shifted tax with a pass-through of 68 percent for high-sugar carbonated drinks. The limitations of the use of CPI data is that the dataset is limited to the most popular brands purchased with restricted product information. However, the authors overcame some of these challenges by matching the CPI data with brand level data from Euromonitor's Passport database.

Catalonia and Portugal, similar to South Africa, introduced banded sugar-sweetened beverage taxes. In Catalonia, the law requires a 100 percent pass-through to consumer prices and therefore Castelló and Casasnova (2019) estimated complete pass-through. Goncalves and Dos Santos (2019) compared pass-through across different sugar content bands in Portugal, and interestingly, found *higher* pass-through for beverages with a lower sugar content. For

example, they found evidence of an over-shift of tax for drinks with less than 80 grams of sugar per litre and found almost full pass-through for drinks with more than 80 grams of sugar per litre. The authors explain this finding with product reformulation, to products below 80 grams of sugar per litre, after the introduction of the tax.

3.3.3: Pass-through and packaging sizes

Pass-through is determined by several factors with packaging sizes being one of the determinants considered. Taubinsky and Rees-Jones (2018) have found that consumers are less aware of price increases on smaller packaging sizes and therefore one could expect higher pass-through on these items. In Mexico, Colchero et al. (2015) estimated larger pass-through for smaller packaging sizes on both carbonated and non-carbonated soft drinks with the pass-through on smaller packaging sizes almost double that of larger packaging with pass-through co-efficients of 0.61 and 0.36, respectively. Cawley, Frisvold, et al. (2018) also found this to be true of Philadelphia's sugar-sweetened beverage prices with reference to larger pass-through on smaller, single servings of regular soda. Stacey et al. (2019) concur with these findings in a South African context. Following the introduction of the Health Promotion Levy in South Africa, they find larger pass-through for smaller packaging with a pass-through rate of 100 percent for 400ml high sugar carbonated beverages in comparison to 51 percent for the same beverages sold in 1.2 litre containers and above. These findings are also consistent with pass-through estimate comparisons across different packaging sizes of other products such as sugar-sweetened biscuits in Mexico (Rueh, 2017) and beer in South Africa (Russell & Van Walbeek, 2014).

3.3.4: Pass-through and consumer or private label branding

Globally private label brands are growing rapidly and exceeding the growth of manufacturer brands (Cuneo, Milberg, Benavente, & Palacios-Fenech, 2015) yet very few researchers have compared sugar-sweetened beverage tax pass-through across consumer branded and private label products. However, Berardi et al. (2016) estimated heterogeneous pass-through results with evidence of under-shifted sugar-sweetened beverage tax for large producer brands in comparison to over-shifted tax on private labels in France.

3.3.5: Pass-through and baseline pricing

There is no evidence of a sugar-sweetened beverage tax pass-through comparison across premium and discount priced brands in the reviewed literature, and other researchers report mixed results across different product categories such as alcohol and cigarettes. Kenkel (2005) found that there is a relationship between alcohol baseline pricing and pass-through, and advised "within a brand, higher baseline prices are associated with lower price increases following the tax hike" (p. 276). Similarly, in terms of tobacco taxes, Chiou and Muehlegger (2010), using a dataset of weekly cigarette sales, found evidence of higher pass-through for discount cigarette brands in comparison to premium priced cigarette brands in Chicago. In contrast, other researchers investigating alcohol taxes do not seem to find any significant differences in pass-through across premium and discount brands (Espinosa & Evans, 2013; Hanson & Sullivan, 2009; Sullivan & Dutkowsky, 2012) and Russell and Van Walbeek (2014) found no significant evidence to suggest that baseline prices for brands of spirits affect pass-through in South Africa.

3.3.6: Pass-through across different retail channels

It is plausible to expect that the retailer channel would impact the extent of tax pass-through due to differing price elasticities of demand across channels, however only a few researchers have conducted this analysis. Despite limited literature available, two studies find similar results. Cawley, Crain, et al. (2018) have found evidence of higher pass-through in both liquor and convenience stores than in grocery stores in Boulder, Colorado, and Falbe et al. (2015) using pricing data collected from stores, found higher pass through on sugar-sweetened beverages in liquor stores, in comparison to supermarkets, in Berkeley, California.

3.3.7: Geographical determinants of pass-through

Geographical determinants may also impact the degree of sugar-sweetened beverage tax pass-through with researchers suggesting higher pass-through for tax jurisdictions located further away from lower taxed states (Harding et al., 2012). Colchero et al. (2015) also estimated heterogeneous pass-through across different regions of Mexico, with an over-shift of tax in Mexico City, Central North, North Border, and the Northwest, but an under-shift elsewhere, particularly marked in the south, one of the regions with the lowest sugar-sweetened beverage prices in the country. Cawley, Frisvold, et al. (2018) also found evidence of higher pass-

through in higher poverty neighborhoods in Philadelphia. Considering the findings of Allcott et al. (2019a) which demonstrate that groups with lower socio-economic positions are generally more responsive to price increases, coupled with the higher pass-through in areas with higher poverty levels, it would be expected that lower-income consumers should receive larger health benefits from the sugar-sweetened beverage tax. Examples to support this notion include larger declines in consumption of sugar-sweetened beverages by lower income consumers as a result of sugar-sweetened beverage tax in the United States (Powell & Chaloupka, 2009), Colombia (Vecino-Ortiz & Arroyo-Ariza, 2018) and in Mexico (World Health Organization, 2017).

3.3.8: The speed of tax shifting

While 'tax shifting' may not occur before the announcement of the tax, the literature suggests that prices respond to sugar-sweetened beverage tax relatively quickly, and generally within three or four months of the introduction of the tax. The quick pricing response positively impacts the effectiveness of the sugar-sweetened beverage tax in combatting obesity. Both Stacey et al. (2019) and Falbe et al. (2015) found that prices responded within three months in both South Africa and California. Shorter adjustment periods were found in Philadelphia with prices adjusting within thirty six days (Cawley, Willage, et al., 2018) and within the first month in Mexico (Colchero et al., 2015). In Chile, prices actually increased immediately after the announcement of the tax (Nakamura et al., 2018).

3.4: Changes in Product Availability and Formulation

A sugar-sweetened beverage tax can influence the availability of different products sold in the market. For example, after the introduction of the sugar-sweetened beverage tax in Philadelphia, Cawley, Frisvold, et al. (2018) found a reduction in the availability of taxed beverages, and an increase in the availability of tax-exempt beverages in the market. Furthermore, a banded tax structure is expected to result in product reformulation, as manufacturers have an opportunity to lower their tax liability. Ludbrook (2019) finds that this is true with reference to 50 percent of sugar-sweetened beverage manufacturers reformulating their products in the United Kingdom after the sugar-sweetened beverage tax was introduced. Stacey et al. (2019) concur with this finding with researchers estimating that a significant number of sugar-sweetened beverage products were reformulated after the introduction of the levy in South Africa.

3.5 Strengths and Weaknesses of the Literature

Most researchers use store-level scanner data to assess sugar-sweetened beverage tax pass-through to overcome certain challenges of survey data, household data, and pricing data, collected for a specific study. The sample sizes of survey data are often small, not all products are accounted for, and not all product information is available. Price variation is often not accounted for, when prices are collected specifically for a study because they are often collected once before, and once after, the introduction of the tax. Household scanner data generally only includes prices for products purchased, and therefore does not account for products with large price increases and large declines in sales (Griffith et al., 2019). Therefore, store-level scanner data that includes all stores within a jurisdiction, can provide for robust and comprehensive assessment of pass-through. However, in South Africa, pass-through studies have relied on survey data, using Consumer Price Index (CPI) data which tracks a standard basket of goods over time (Linegar & Van Walbeek, 2015; Russell & Van Walbeek, 2014; Stacey et al., 2019). Therefore, the analysis of store-level scanner data, reflecting actual sales made in-store across all brands and products, in this study will provide for an accurate estimate of pass-through in South Africa. No study has estimated pass-through for fruit juice in South Africa and therefore this study provides an opportunity for unique assessment.

Globally, researchers tend to use 'difference-in-difference' methodology in order to assess pass-through because this approach compares a test group (taxed jurisdiction) to a control group (tax-exempt jurisdiction) to determine causality (Griffith et al., 2019). Unlike the United States, South Africa's levy is a national tax and manufacturers generally produce both taxed and tax-exempt products, and therefore have the ability to adjust prices of both products, accordingly. Therefore, finding a valid control group is difficult within a South African sugar-sweetened beverage tax context. However, similarly to South Africa, in Mexico Grogger (2017) overcame this challenge by using untaxed comparison goods, which are not substitutes, as a control group to determine causality.

Both global and South African literature provide comprehensive analysis across different pass-through determinants including beverage categories (Berardi et al., 2016; Cawley, Frisvold, et al., 2018; Colchero et al., 2015; Silver et al., 2017) and packaging sizes (Cawley & Frisvold, 2015; Colchero et al., 2015; Falbe et al., 2015; Linegar & Van Walbeek, 2015; Rueh, 2017; Russell & Van Walbeek, 2014; Stacey et al., 2019). There is also extensive analysis of the time

that it takes for prices to adjust to the tax (Cawley & Frisvold, 2015; Falbe et al., 2015; Harris, 1987; Linegar & Van Walbeek, 2015; Nakamura et al., 2018; Young & Bielinska-Kwapisz, 2002). However, very few of the global studies and none of the South African studies evaluate pass-through in the different retail channels, despite the trend in convenience being one of the main drivers of the growth in packaged goods and beverage sales in South Africa since 1994 (Ronquest-Ross et al., 2015). Broda, Leibtag, and Weinstein (2009) have found that consumers in the United States pay on average 11 percent more for the same goods in convenience versus grocery stores, indicating differentials in price elasticities of demand across the different places of sale.

3.6: Summary

Thus, some conclusions can be drawn from the review of the literature on pass-through across alcohol, cigarettes, and sugar-sweetened beverages. One conclusion is that prices of taxed sugar-sweetened beverages respond, on average, to sugar-sweetened beverage taxes with significant increases in price after the introduction of a sugar-sweetened beverage tax. Despite research yielding heterogeneous results with evidence of both under- and over-shifted tax, a majority of global studies, and evidence from a South African study, estimate the sugar-sweetened beverage tax as having an under-shift effect. Furthermore, the literature suggests larger pass-through for carbonated soft drinks and smaller packaging sizes with price increases occurring within the first three to four months of a tax change. It is apparent that most researchers have utilised store level pricing data to conduct their studies, providing for more robust analysis and including an estimation of pass-through across different sales outlets and provinces. Although pass-through methodologies differ slightly according to the availability of data and the context of research questions, a majority of studies use ‘difference-in-difference’ methodology to determine causality between the sugar-sweetened beverage tax and consumer price increases.

Chapter 4: RESEARCH METHODOLOGY AND DATA

4.1: Hypothesis Development

To answer the main research question, the following hypotheses were developed from the pass-through literature reviewed:

H1 Real prices of taxed fruit juices increase after the introduction of the Health Promotion Levy

H2 Real prices of taxed fruit juices increase by an amount less than the total tax amount after the introduction of the Health Promotion Levy

H3 There is an increase in the number of tax-exempt juices sold, and a decrease in the number of taxed juices sold, in the market, after the introduction of the Health Promotion Levy

The data and methodology used to test the above hypotheses are discussed in detail in the sections that follow.

4.2: Research Approach

The main aim of the research is to examine the relationship between the Heath Promotion Levy and the retail prices of fruit juices after the introduction of the levy in South Africa. There are various approaches to estimating pass-through using different types of data. I seek to develop insights by way of rigorous statistical analysis using a secondary dataset of store-level scanner data with a 'before-and-after comparison' method employed by Stacey et al. (2019) who used Consumer Price Index data to determine the pass-through of the Health Promotion Levy on carbonated soft drinks in South Africa.

Quantitative research involves the interpretation and understanding of numerical data to determine the relationship between variables (Byrne, 2017). As this study focuses on the relationship between the levy and prices of fruit juice, a quantitative research strategy was implemented. Deductive reasoning involves the generation of different hypotheses which are rejected or accepted based on the analysis of the data (O'Leary, 2007). I utilised a deductive approach to interpret the relationship between the dependent and independent variables, namely the price and levy respectively, one year before, and one year after, the levy was introduced. This study is limited to two retail groups, but I utilised a positivist view in assuming similar results to be evident in other retailer groups in South Africa (Burrell & Gross, 2018).

4.3: Research Assumptions

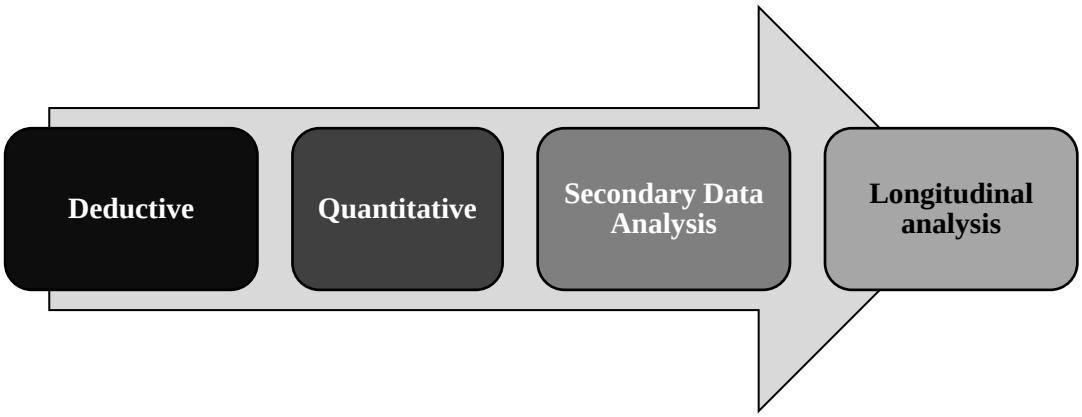
To answer the main research question through analysis of electronic point of sale data of fruit juice prices in retail, the following assumptions are made:

- The data collected from the two retailer groups accurately reflects the retail market in South Africa
- The sales data collected from the retailers is accurate
- The sales data collected from the retailers includes all sales of fruit juices for the period of April 2017 to March 2019
- The sugar-content readings from the nutritional labels of product packaging is accurate
- The integrated data from the data management organisation's cloud-based platform is accurate

4.4 Research Design

The research design is summarised in Figure 1 below with longitudinal studies involving the analysis of variables over a period of time in order to analyse changes in the dependent variable (Kumar, 2011). This study analyses secondary data over a twenty-four-month period making the study longitudinal in nature. Experimental design determines the cause and effect relationship between variables by using a control and experimental group (Kumar, 2011). For this study, a causal design was not viable, as I did not have access to data for an accurate control group. Despite this limitation, the analysis conducted compared results across both taxed and tax-exempt fruit juice categories.

Figure 1: The Research Design



4.5: Data

The study utilised an existing quantitative dataset containing electronic point of sale data for the short life fruit juice category from April 2017 until March 2019, secured from two of South Africa's three largest retailers. The dataset selected is administrative because it has not been collected for research purposes, but rather for the purpose of transaction between organisations, where the dataset is used to monitor the sales performance of products in comparison to competitors (Connelly, Playford, Gayle, & Dibben, 2016). The advantages provided by the administrative dataset utilised are several: a large sample size; tax and tax-exempt products are included; the time frame shows prices before *and* after the introduction of the levy.

The data set is of high quality because the data refers to actual sales through the till in-store. In-store, individual product barcodes are scanned through electronic point of sale scanners when sold. The scanners reflect detailed product information such as the product description, packaging size, quantity and sales price at the point of sale. The store level data, retrieved from the scanners, is then aggregated and collated by retailers and distributed to producers on a monthly basis for a fee, which is calculated as a percentage of the producer's sales. The data comes from a producer who pays a reputable company to check, clean, and integrate the information on their cloud-based platform on a monthly basis. The data is validated by teams of analysts who inspect the marginal frequencies to determine and correct any errors within the dataset (Mouton, 2001).

The data is aggregated from individual store level to the retailer store type. For example, all transactional data from Hyper Stores of one retailer, Retailer A, is aggregated to a Retailer A Hyper Store level. The aggregated sample at the individual product level includes 314 960 retail prices for fruit juices across different months, retailer store types, and provinces.

The dataset is multi-group including the following variables:

- Numeric variables – revenue, litres, and price
- Categorical variables – year, month, product description, juice category, brand, flavour, packaging size, province, retailer group, retailer store type, and retailer channel

The dataset includes sales data for different categories of juice namely 100% juices, fruit drinks, nectars, and long-life nectars. The South African fruit juice association (2019) defines the sub categories as follows:

- **100% Juice**: A "100% juice will consist of the natural juice of the named fruit(s), with the possibility of permitted preservatives, citric acid, ascorbic acid, carbon dioxide, natural essences / aromas. It does not contain added sugars derived from any other source" (para. 24).

- **Fruit Nectar**: A nectar "consists of juice and water with or without the addition of sugar. The resulting beverage would contain at least 12.5% juice in the case of lemon or lime and up to 50% in the case of fruits like apple and orange. The minimum amount of fruit juice content is legislated in the regulations" (para. 14).

- **Fruit Drink**: A fruit drink is a "mixture of juice and sugar with or without the addition of water, with the exception that the juice content is much lower. A fruit drink has a fruit content of only 6%" (para. 15).

- **Long-life nectar**: A long-life nectar is a nectar that requires the addition of water before use. Long-life nectars are ambient products which are located on the shelf, in contrast to the fridge, in retail stores.

To determine the tax liability per product after the introduction of the levy in order to calculate pass-through, data was collected on the sugar content of each product in person, at store, and online, by checking the nutritional information on the label of products. The data was collected in person because the sales data that was utilised for the study did not contain any information regarding the sugar content of each product. Similarly, Stacey et al. (2019) collected post-tax sugar content data for carbonates through in-store observation. The authors compared the sugar content of different carbonate brands before, and after, the introduction of the levy, and utilised

pre-tax sugar content data from a Coca-Cola company publication and Euromonitor report. However, the dataset utilised for this study contains sales data for 1 120 individual products and 99 brands in the pre-tax period and therefore a lack of access to pre-tax sugar content data for the magnitude of products covered, and time restrictions, made it not possible to determine the pre-tax sugar content of each product.

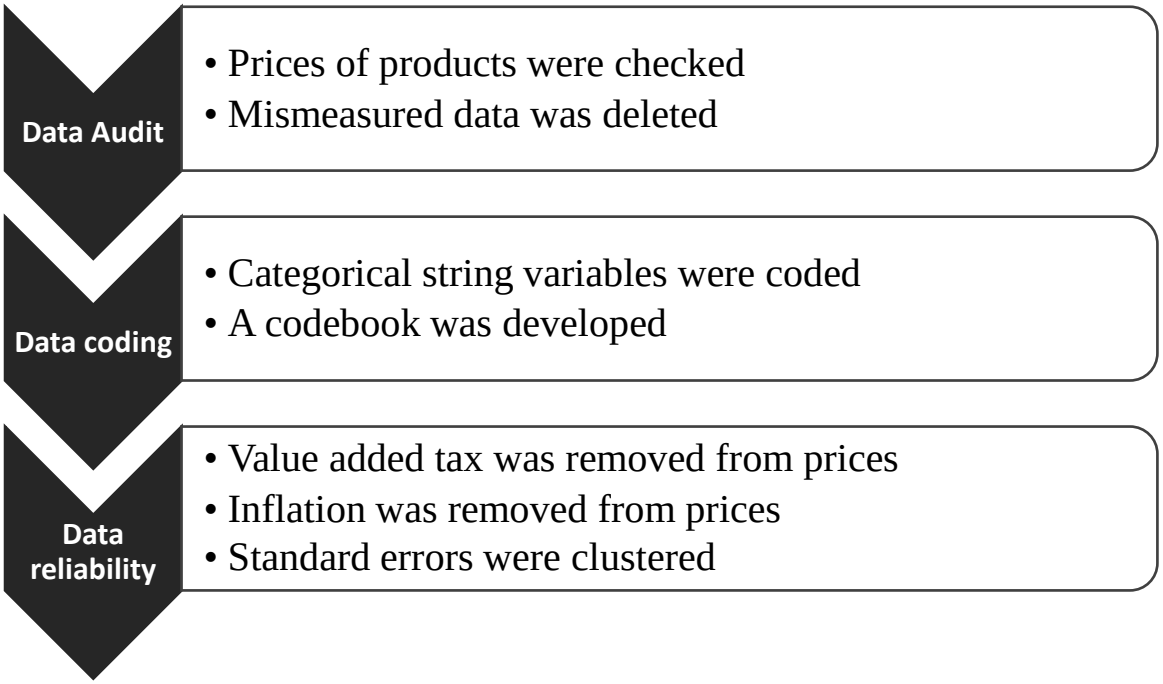
Nutritional labelling is not compulsory in South Africa unless certain claims are made on product labels[8]. Therefore, there are brands that do not include any nutritional information on their packaging. However, South African legislation requires manufacturers, importers, packers, and retailers, to adhere to the Agricultural Product Standards Act, 1990 (Act No. 119 of 1990) whereby these parties are required to use minimum brix[9] for each flavour of fruit nectar in production. To overcome the study's limited access to data regarding sugar content of each fruit juice product contained in the sample, the minimum brix requirements from the Department of Agriculture, Forestry and Fisheries was chosen and these minimum requirements were applied to each outstanding nectar flavour. The sub sample of taxed juice products whose prices increased post-tax, and for which the sugar content could be estimated, amounted to 75 408 observations. The sub sample included fruit drink and nectar products and the 75 408 observations accounted for approximately 85 percent of total fruit drink and nectar revenues.

Before statistical data analysis could be conducted, the data was checked, consolidated, and cleaned, as per the data preparation process below:

[8] Sugar-sweetened beverage manufacturers are required to run sugar tests on their products through the South African National Accreditation System (SANAS) or the International Laboratory Accreditation Cooperation (ILAC) accredited testing facilities in order to determine their tax liability and therefore should possess accurate sugar readings, however it is possible that producers are mislabelling products.

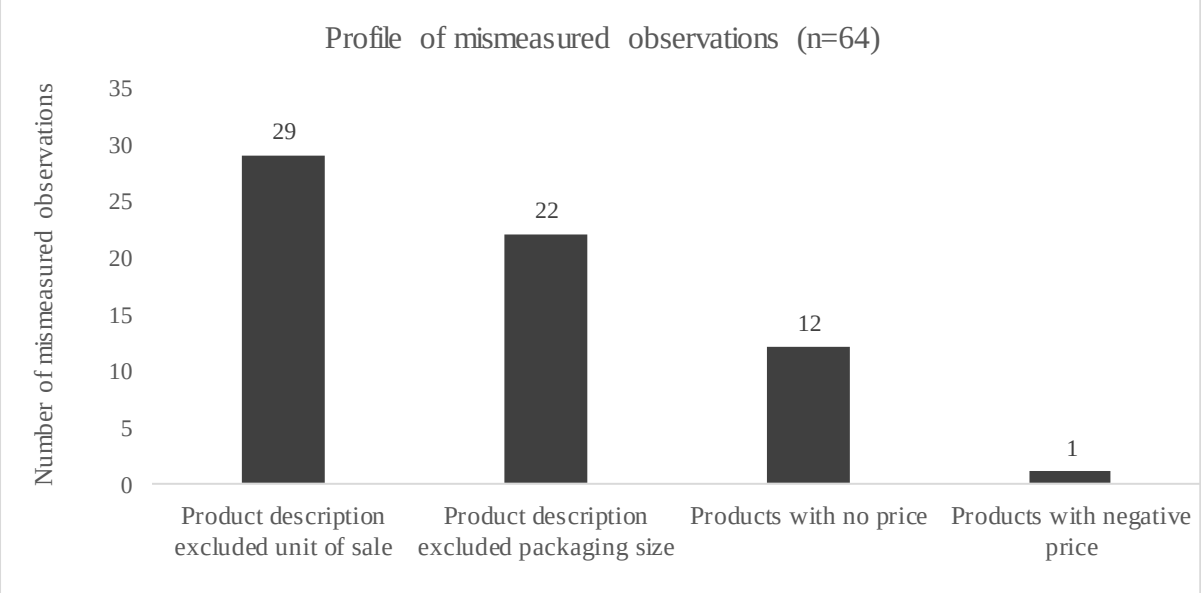
[9] Brix refers to the percentage of a solid, in this instance sugar, included in a solution. A solution with one-degree brix equates to one gram of sucrose per 100 grams of solution (Ball, 2006). The minimum brix per flavour of fruit nectars is legislated in South Africa and given that legislation sets a minimum reading for brix, the actual sugar content of the beverages could be higher.

Figure 2: Data preparation process



The dataset was audited, and observations identified that contained errors. These were classified as mismeasured. The mismeasured observations were deleted and included 64 price observations at the month-retailer sub group-province level and represented 0.0002 percent of the total dataset revenues. Their exclusion had no significant impact on the results of the study. Observations were classified as 'mismeasured' if the observation did not include a price due to certain products containing zero sales within a specific month; observations which included a negative price due to larger returns than sales within a specific month; and when product descriptions excluded specific product details such as the packaging size or unit of sale (individual units or cases) as illustrated below:

Figure 3: Profile of 'mis-measured' observations



Notes: Figure 3 shows a breakdown of the number of observations deleted from the dataset used for the 'before and after' pricing comparison and an explanation as to why the observations were classified as 'mismeasured.'

Source: Author

4.6: Sampling

Sampling is vital in ensuring that the findings from a study from a specific sample are able to be generalised to the broader population (Bryman & Bell, 2007). However, no sampling technique was necessary, and therefore applied, to this study because the quantitative dataset encapsulated all short life fruit juice sales within all stores of the largest and the third largest retailer groups in South Africa. These retailer groups had a combined annual food and grocery revenue market share of approximately thirty five percent in South Africa in 2017 (MarketLine, 2018) and operate more than 1 500 stores across all provinces of South Africa. They cater for a broad range of low, middle- and high-income shoppers by providing both speciality foods and beverages as well as discounted, bulk offerings.

4.7: Methodology

Drawing up the research strategy to answer the main research question, a reference has been made to Stacey et al. (2019) who estimated pass-through of carbonated soft drinks in South Africa in 2019 using a 'before and after' comparison methodology. A similar methodology has

been applied to this study and includes three different econometric approaches. Firstly, the prices of both taxed, and tax-exempt, fruit juices were assessed before and after the tax was implemented, secondly, the price increase was compared to the actual tax liability in order to determine the pass-through of the levy, and thirdly, in order to assess producer behaviour after the introduction of the levy, the number of products from the different juice categories were assessed before and after the introduction of the levy.

Various statistical programmes are available to help discover and quantify relationships between variables in data (Walliman, 2011) and they offer various advantages such as a range of statistical procedures, user-friendliness, the testing of assumptions, and the development of graphs (Leedy & Ormrod, 2016). StataCorp version 14.2 was used to conduct linear regression models for all three economic approaches and standard errors were clustered at the month-retailer sub group-province level. The first approach estimated regressions using average real prices per litre as the dependent variable, and the pre-tax and post-tax period as the independent variable as shown in the equation below:

$$Price_{myisp=}\alpha_1 Post_{my} + \boldsymbol{\beta_{1Prod}} + \boldsymbol{\beta_{2Ret}} + \beta_{3_p} + \boldsymbol{\beta_{4Per}} + \varphi_{myisp} \quad (1)$$

where *m* indexes month, *y* indexes year, *i* indexes product, *s* indexes retailer sub group and *p* indexes province. $Post_{my}$ is an indicator variable identifying months after the introduction of the levy in April 2018; β_{1Prod} is a vector of juice category, brand, product, and flavour; β_{2Ret} is a vector of retailer group, retailer sub group and retailer channel; $\beta_3 p$ is a province fixed-effect; β_{4Per} is a vector of month and year; and φ_{myisp} is an idiosyncratic error term. As the before-after analysis assumes that, in the absence of the tax, prices would have been identical to their levels prior to the introduction of the tax, other variables affecting price need to be controlled (Griffith et al., 2019). Various price determinants such as year, month, juice category (taxed and tax-exempt), brand, consumer branded or private label products, premium or discount priced brands, flavour, packaging size, retailer group, retailer channel, retailer sub group (store type), and province, were used as control variables to account for any pricing impacts.

The second approach to calculate pass-through used the same variables and controls as described above, however the actual tax liability per product was calculated and used as the dependent variable when estimating regressions as shown in the equation below:

$$Price_{myisp=}\alpha_2 Levy_{ibmy} + \boldsymbol{\beta_{5Prod}} + \boldsymbol{\beta_{6Ret}} + \beta_{7_p} + \boldsymbol{\beta_{8Per}} + \varphi_{2_{myisp}} \quad (2)$$

Where $Levy_{ibmy}$ is the HPL rate per litre on product *i* of brand *b* in month *m* and year *y*. $Levy_{ibmy}$ takes the value of zero for periods prior to the introduction of the levy in April of 2018. For later periods, $Levy_{ibmy}$ is calculated based on the sugar content of the product, $Sugar_i$, as follows:

$$Levy_{ibmy} = \begin{matrix} 0 & if\ sugar_i < \frac{4g}{100ml} \\ (sugar_i - 4) * 0.021 * 10 & if\ sugar_i \geq \frac{4g}{100ml} \end{matrix} \quad (3)$$

To accurately measure pass-through, the analysis was restricted to taxed juices with mean price per litre increases post-tax, on an individual product basis. Fruit drink and nectar products launched after the introduction of the levy were excluded from the analysis. Long-life nectars were excluded from the analysis because they require water to be added to the product before consumption, and the tax liability is calculated relative to the reconstituted volume. The data used does not include reconstitution factors, and therefore the research is unable to construct a price per diluted litre for long-life nectars.

The final approach calculated a variable for the number of products sold within a specific retailer sub group per province, per month. The regression estimated below, utilised the product count variable as the dependent variable, the pre-tax and post-tax period as the independent variable, and controlled for the month, the juice category, the retailer sub group and the region.

$$Product\ count_{mysp=}\alpha_3 Post_{my} + \beta_{9_j} + \beta_{10_s} + \boldsymbol{\beta_{11_{per}}} + \varphi_{3_{mysp}} \quad (4)$$

where *m* indexes month, *y* indexes year, *s* indexes retailer sub group and *p* indexes province. Economists often use dependent variables in logarithmic form in order to show how the dependent variable changes with the independent variable, represented by a percentage change (Wooldridge, 2013). The product count variable is in logarithmic form and estimates the percentage change in the number of products sold after the introduction of the levy. $Post_{my}$ is an indicator variable identifying time periods post the introduction of the levy in April 2018; β_{9j} is a juice category fixed-effect; β_{10s} is a retailer sub category fixed-effect; β_{11Per} is a vector of month and year; and φ_{3mysp} is an idiosyncratic error term.

Descriptive statistics were generated to show the general nature of the data, to determine the variability within the dataset, and to highlight the associations between variables (Leedy & Ormrod, 2016).

4.8: Validity and Reliability

Validity in the context of quantitative research refers to a validity of measurement and whether tests conducted accurately measure what has been communicated as being tested. In quantitative studies, both internal and external validity need to be verified, whereby internal validity refers to how accurately a study has measured the cause and effect relationship between independent and dependent variables, and external validity refers to the ability of the study to infer results in different or real life contexts (Bielenia-Grajewska, 2019).

On the same day that the Health Promotion Levy was introduced in South Africa, the value added tax rate (VAT) changed from 14% to 15% and therefore the analysis conducted in this study was based on prices exclusive of VAT in order to exclude the VAT increase effect on prices. South Africa's tax is a national tax and therefore different provinces cannot be used as a control group to test causality. However, results were analysed across both taxed and tax-exempt products. The administrative dataset used in this study is externally valid because most retail fruit juice brands are sold by formal retailers in South Africa, and therefore the results can be inferred for other retailers in South Africa. Furthermore, the data used provides content validity because all content regarding the instrument was included in the test (Heale & Twycross, 2015).

Reliability refers to the consistency of a measure whereby the results of the test should be the same each time the measure is tested (Heale & Twycross, 2015). In order to ensure that results were statistically reliable, I analysed both standard errors to determine the degree of precision, and 'R-squared' to determine the degree to which the change in price is explained by the introduction of the Levy. The explanatory power of the model is strengthened by the use of various control variables including months to account for seasonality.

Long and Ervin (2000) explain that linear regression models can be inefficient in estimating parameters when standard errors are *heteroscedastic*, and describe the occurrence of heteroscedasticity as follows: "when the variance of the errors varies across observations" (p. 217). This heteroscedasticity can occur when standard errors are influenced by explanatory variables. For example, prices of sugar-sweetened beverages may vary in a particular provincial retailer, or in a particular month, due to factors unrelated to the levy, such as drought, changes in management, resulting pricing strategies of a retailer or the occurrence of a particularly warm month. Therefore, in estimating equations 1, 2 and 4, standard errors were clustered at the month-retailer sub group-province level in order to account for changes in a

particular cluster (retailer, region, and month) and to correct standard errors for heteroscedasticity, in order to ensure that the regressions provide efficient and unbiased estimates.

4.9: Research Limitations

It is acknowledged that the research design has a few notable limitations. Firstly, the introduction of the levy was delayed by one year and the 'before and after' econometric approaches do not account for pricing changes (as a result of the tax) before the introduction of the levy. Secondly, in the calculation of pass-through, the sugar content was not available for all fruit juice products and these products, without sugar content data, were excluded from the dataset used to analyze pass-through. However, as all the products with a large contribution to revenue were accounted for, the exclusion of the brands for which no data was available, should not statistically impact the results. As the minimum legislated brix amount was used to calculate the sugar content of outstanding nectars by flavour, pass-through estimates could potentially be overstated. However, for the sample of nectars for which the sugar content could be obtained from nutritional labels, the calculated brix amount was not significantly lower than the actual sugar content and therefore the calculated brix amounts should not statistically impact pass-through results. Lastly, I did not have access to the costs faced by producers, and therefore could not include this as a control variable when conducting the regression analysis. However, real cost increases faced by producers could impact consumer prices. A monthly control variable was however used to control for seasonal fluctuations in prices and the time frame of only twelve months after the introduction of the tax was too short to account for any fundamental shifts in the cost of production.

Chapter 5: RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

5.1: Characteristics of the Data

Descriptive statistics for the full analytical sample are contained in Table 10, included in the appendix and summarised in Table 3 below. The table provides a breakdown of the share of both real revenue and sales volumes for each juice category with taxed juices representing the largest proportion of sales revenues and volumes prior to the introduction of the levy in South Africa. However, after the introduction of the levy, both sales volumes and real revenues of tax-exempt fruit juices increased, whereas both sales volumes and real revenues of all taxed juice categories decreased as illustrated in figures 4 and 5 below. The changes resulted in taxed, and tax-exempt juices contributing to an equal proportion of total real revenues after the introduction of the levy. Fruit drinks were the most commonly bought juices in sales volumes before the levy was introduced, and 100% juices were the most commonly bought after the introduction of the levy. This change can be partly explained by the eight percent increase in the number of tax-exempt products sold and the one percent decline in the number of taxed juice products sold after the introduction of the levy.

Across all juice categories, the average real price per litre increased by five percent after the introduction of the levy, with larger price increases of taxed juices in comparison to tax-exempt juices. As shown in figure 6 and 7 below, the prices of tax-exempt juices declined from February 2018 and March 2018 onwards for single and bulk containers respectively and remained stable from April 2018 onwards, the month that the Health Promotion Levy was introduced. Immediate price increases in April 2018 are evident amongst both single serve and bulk containers of taxed juices. However, the pricing structure across juice categories is consistent in both pre-tax, and taxed, periods reviewed, with the mean retail price per litre highest amongst tax-exempt, 100% juices. In figures 8, 9, 10 and 11 included in the Appendix, it is evident that volumes of fruit juice responded to the price changes with large increases in the number of litres of tax-exempt single serve containers sold from April 2018 onwards, and a huge spike in the volumes of tax-exempt bulk juice sold in April 2018. There also appeared to be a large decline in the volumes of taxed bulk juices sold from May 2018 onwards.

Table 10 illustrates that bulk containers (750mls and above) dominate real revenues with a 74 percent real revenue share, however single serve containers (500mls and less) drove revenue growth with a 51 percent growth in annual real revenue after the levy was introduced, which suggests a change in purchasing behaviour. Most juice sales occur within the grocery channel

which represents 89 percent of total price observations, and 96 percent of real revenues of juices. All nine provinces of South Africa are represented in the sample with the highest mean retail price per litre for fruit juice in Gauteng and Mpumalanga, and the lowest price in the Northern and Eastern Cape, before the introduction of the levy.

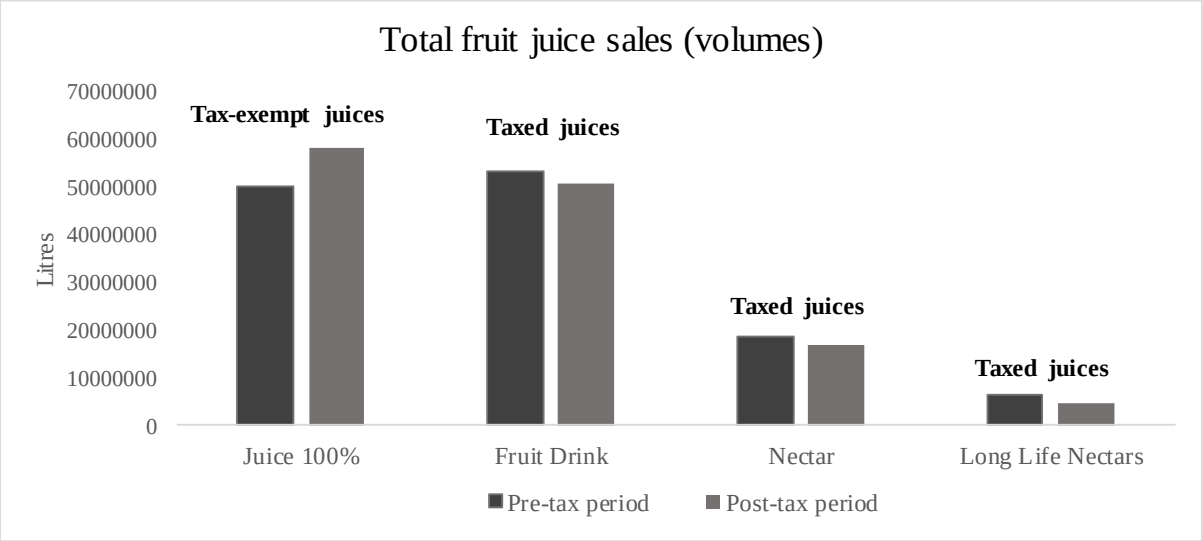
Table 3: Descriptive statistics from the sample (summary)

	Tax-exempt juices	**Taxed juices**				**Total juices**
	Juice 100%	**Total**	**Fruit Drink**	**Nectar**	**Long Life Nectars**	**Total**
Average Real Price per litre (Pre-tax)	R20.44	R16.65	R17.19	R13.73	R18.19	R18.18
Average Real Price per litre (Post-tax)	R20.95	R17.64	R18.77	R14.27	R17.87	R19.08
Post-tax Price per litre difference	R0.51	R0.99	R1.59	R0.54	-R0.32	R0.90
Post-tax Price per litre difference %	3%	6%	9%	4%	-2%	5%
Brands (Number)	45	81	60	28	15	99
Flavours (Minimum number)	24	28	26	16	14	31
Products (Number) - Pre-tax	396	724	436	177	111	1 120
Products (Number) - Post-tax	429	714	430	199	85	1 143
Post-tax products difference	33	-10	-6	22	-26	23
Post-tax products difference %	8%	-1%	-1%	12%	-23%	2%
Real Revenue (share) - Pre-tax	45%	55%	39%	12%	4%	100%
Real Revenue (share) - Post-tax	50%	50%	36%	11%	3%	100%
Real Revenue (share) - difference	5%	-5%	-3%	-1%	-1%	0%
Sales volumes (Litres share) - Pre-tax	39%	61%	41%	14%	5%	100%
Sales volumes (Litres share) - Post-tax	45%	55%	39%	13%	4%	100%
Observations	131 909	183 051	114 523	39 097	29 431	314 960

Notes: Table 3 shows a summary of the descriptive statistics for the price data from two of South Africa's three biggest retailers. Prices are in per-litre terms and reflect real prices adjusted to December 2016 using monthly Consumer Price Index data, and excluding value added tax. Similarly, real revenue has been adjusted to December 2016 using monthly Consumer Price index data and excluding value added tax.

Source: Author

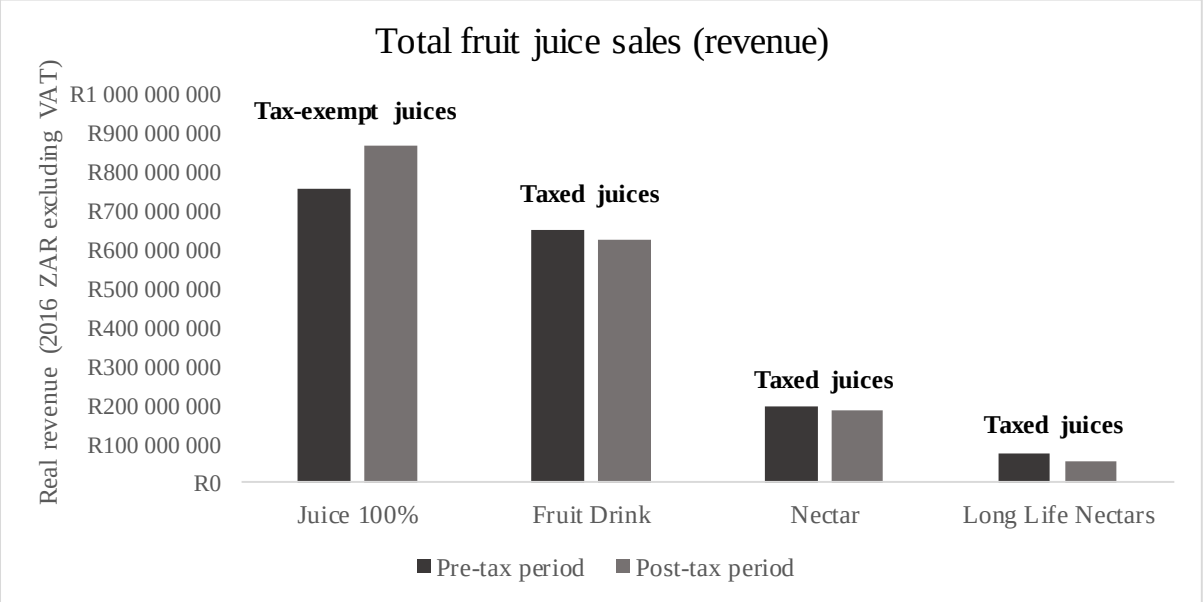
Figure 4: Fruit juice sales (volumes)



Notes: Figure 4 shows the total litres of fruit juice sold, by juice category at two of South Africa's largest retailers. The pre-tax period refers to April 2017 to March 2018 and the post-tax period refers to April 2018 to March 2019.

Source: Author

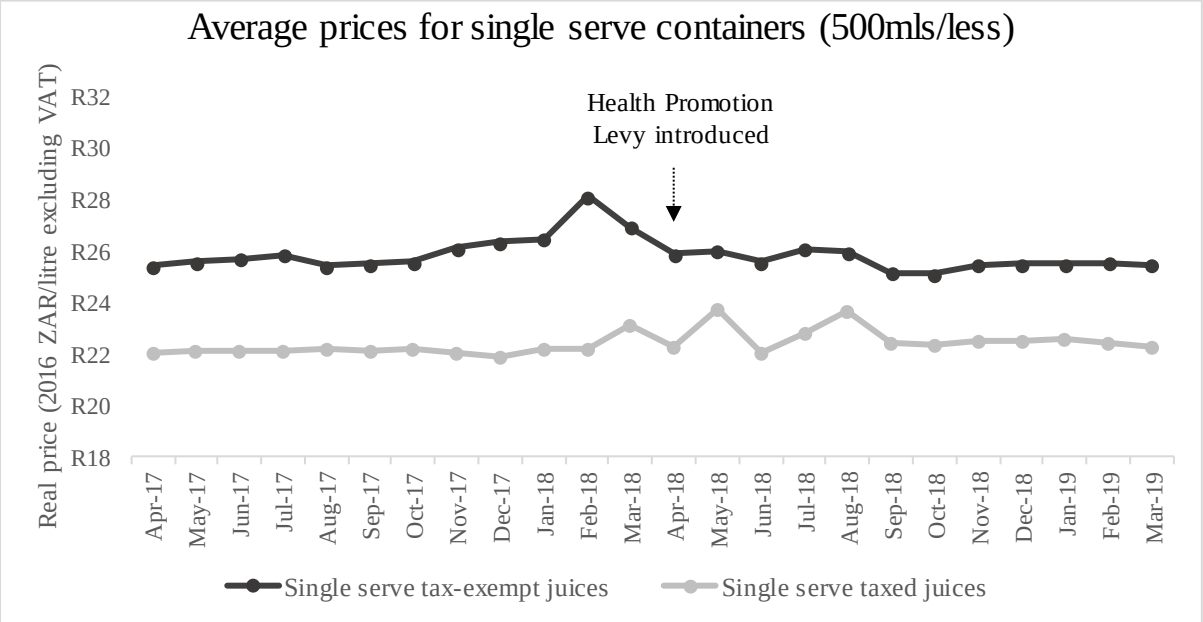
Figure 5: Fruit juice sales (real revenue)



Notes: Figure 5 shows the total real revenue, adjusted to December 2016 prices and excluding value added tax on fruit juice, by juice category, in two of South Africa's largest retailers. The pre-tax period refers to April 2017 to March 2018 and Post-tax period refers to April 2018 to March 2019.

Source: Author

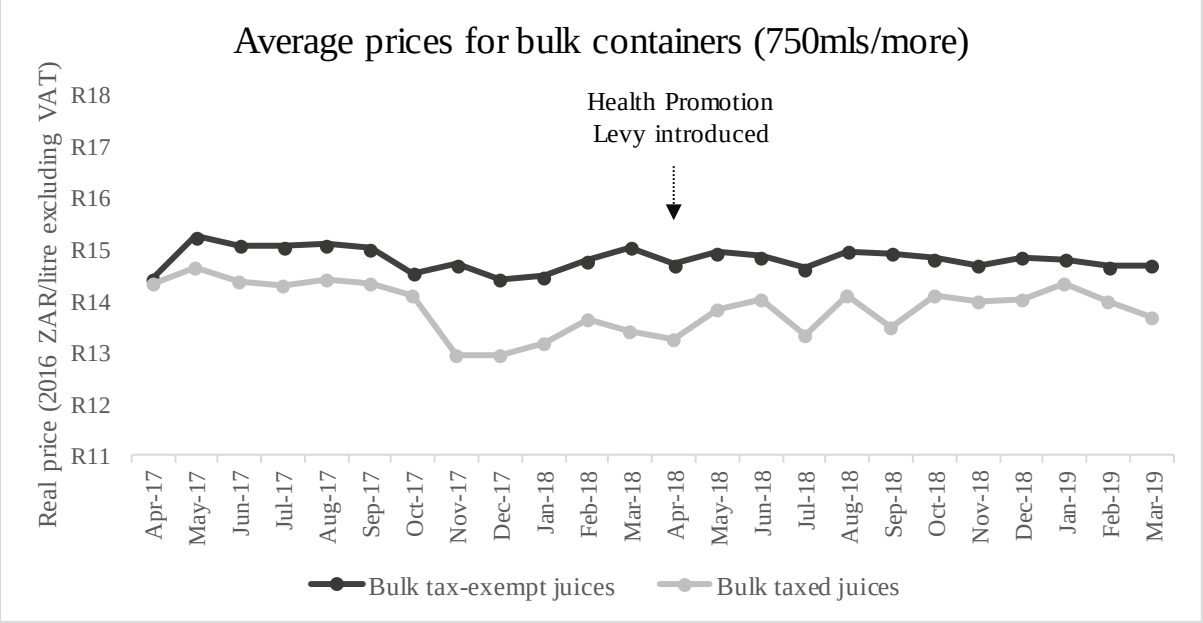
Figure 6: Single serve fruit juice prices



Notes: Figure 6 shows the average prices, adjusted to December 2016 prices and excluding value added tax, of fruit juice in single serve containers, by taxed, and tax-exempt, juice categories, at two of South Africa's largest retailers.

Source: Author

Figure 7: Bulk fruit juice prices



Notes: Figure 7 shows the average prices, adjusted to December 2016 prices and excluding value added tax, of fruit juice in bulk containers, by taxed, and tax-exempt, juice categories, at two of South Africa's largest retailers.

Source: Author

5.2: Price Changes After the Introduction of the Health Promotion Levy

The regression results in Table 4 present estimates of price changes after the introduction of the levy. Panel A presents the regression estimates across all packaging sizes, while Panel B and Panel C, present results of the analysis separately by packaging size and Panel D, E and F, by retailer channel. The analysis was conducted across all juice categories represented in the sample, and the estimates show statistically significant increases in the prices of all taxed fruit juice categories after the introduction of the Health Promotion Levy. Specifically, real price per litre for taxed fruit juices was 0.305 ZAR higher after the levy, on average. This result supports hypothesis H1 (real prices of taxed fruit juices increase after the introduction of the Health Promotion Levy.) Interestingly and as expected, there is no statistically significant change in prices for tax-exempt juices after the introduction of the levy. The increase in taxed juice prices is highest amongst fruit drink products, and lowest amongst long life nectars with a 0.294 ZAR and 0.207 ZAR increase in the real price per litre, respectively.

There is substantial variation in the change in prices across different packaging sizes after the introduction of the levy, with statistically significant 0.307 ZAR per litre price increases, on average, of smaller, single serving containers (500mls or less) and no statistically significant change in the price of larger, bulk containers (750mls or more). There is also substantial variation in the price change across different juice categories with significant increases of both taxed, and tax-exempt, juices in smaller, single serving, containers with estimates ranging from 0.169 ZAR per litre price increases of 100% juices to 0.580 ZAR per litre price increases of fruit drinks. Larger, bulk containers present heterogeneous results across different fruit juice categories with price per litre changes ranging from a 0.125 ZAR decline for tax-exempt 100% fruit juices, to a 0.210 ZAR increase for taxed fruit drinks.

There is also substantial variation in the change in prices of different fruit juice categories across different retailer channels, with statistically significant per litre price increases of 0.106 ZAR on average in grocery stores, price increases of almost three times larger in convenience stores with price increases of 0.300 ZAR per litre on average, and no evidence of statistically significant price increases in online stores. The price changes also vary across juice category with statistically significant price increases across all taxed fruit juices in grocery stores with estimates ranging from 0.203 ZAR per litre on average for nectars, and 0.293 for fruit drinks. The estimates show price increases of both taxed, and tax-exempt, fruit juices in convenience stores with the average per litre price increase higher for tax-exempt juices at 0.388 ZAR, in comparison to 0.317 ZAR per litre price increases for taxed juices on average.

Table 4: Estimates of the price changes across different juice categories

	Tax-exempt juices	Taxed juices				Total juices
	Juice 100%	**Total**	**Fruit Drink**	**Nectar**	**Long Life Nectars**	**Total**
Panel A - All packaging sizes						
Post	-0.002 (0.047)	0.305*** (0.035)	0.294*** (0.038)	0.225*** (0.033)	0.207*** (0.066)	0.131***(0.035)
Observations	131 909	183 051	114 523	39 097	29 431	314 960
R-squared	0.902	0.844	0.923	0.923	0.844	0.870
Panel B - Single serving (500ml or less)						
Post	0.169*** (0.066)	0.570*** (0.054)	0.580*** (0.061)	0.396*** (0.059)	1.57 (3.57)	0.307*** (0.052)
Observations	70 454	69 929	55 937	13 946	46	140 383
R-squared	0.876	0.890	0.894	0.809	0.821	0.866
Panel C - Bulk (750ml or more)						
Post	-0.125***(0.034)	0.120*** (0.036)	-0.092** (0.045)	0.153*** (0.028)	0.210*** (0.066)	0.026 (0.027)
Observations	61 455	113 122	58 586	25 151	29 385	174 577
R-squared	0.799	0.836	0.873	0.806	0.839	0.826
Panel D - Grocery stores						
Post	-0.047 (0.050)	0.304*** (0.037)	0.293***(0.040)	0.203*** (0.034)	0.243*** (0.074)	0.106*** (0.036)
Observations	116 817	162 688	103 077	35 284	24 327	279 505
R-squared	0.903	0.848	0.920	0.923	0.847	0.874
Panel E - Convenience stores						
Post	0.388***(0.098)	0.317*** (0.090)	0.299***(0.111)	0.481*** (0.084)	0.038 (0.092)	0.300*** (0.082)
Observations	13 682	18 114	10 592	3 454	4 068	31 796
R-squared	0.908	0.837	0.945	0.940	0.861	0.854
Panel F – Online						
Post	0.139 (0.243)	-0.037 (0.198)	0.365 (0.288)	0.200 (0.157)	-0.025 (0.212)	0.083 (0.200)
Observations	1 408	2 218	843	339	1 036	3 626
R-squared	0.955	0.913	0.966	0.883	0.886	0.926

Notes: Table 4 shows results of the price regressions using price data from two of South Africa's three biggest retailers. Prices are in per-litre terms and reflect real prices adjusted to December 2016 and excluding value added tax. Robust standard errors clustered at the province-retailer-month level in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Source: Author

5.3: Pass-Through of the Health Promotion Levy on Fruit Juices in Formal Retail South Africa

The regression results in Table 5 present the findings for the price increase relative to the tax liability of the Health Promotion Levy and the results show that both producers and consumers of taxed fruit juices share the burden of the tax with an overall pass-through coefficient of 0.332 ZAR, estimated. This suggests that for every R1.00 of sugar-sweetened beverage tax, fruit juice

prices have increased by R0.33 per litre on average. This result supports H2 (real prices of taxed fruit juices increase by an amount less than the total tax amount after the introduction of the Health Promotion Levy.) The estimate of pass-through across different price determinants concurs with the total pass-through co-efficient estimated with evidence of under-shifted tax across all price determinants.

The regression results do however reveal considerable heterogeneity in pass-through across different product attributes. Despite evidence of under-shifted tax on both fruit drinks and nectars, pass-through estimates are significantly larger for fruit drinks with a pass-through coefficient of 0.687 which is almost three times the degree of pass-through observed for nectars at 0.260. This therefore highlights a significantly higher tax burden on consumers of fruit drinks in comparison to consumers of nectars.

Table 5: Pass-through of the Health Promotion Levy

	Total	**Fruit drinks**	**Nectars**
Tax per Litre (2016 ZAR/litre)	0.332*** (0.027)	0.687*** (0.038)	0.260*** (0.031)
Observations	75 408	48 197	27 211
R-squared	0.920	0.912	0.927
	Total	**Single serve 500mls or less**	**Bulk sizes 750mls or more**
Tax per Litre (2016 ZAR/litre)	0.332*** (0.027)	0.552*** (0.045)	0.243*** (0.024)
Observations	75 408	46 678	28 730
R-squared	0.920	0.827	0.833
	Total	**Consumer brands**	**Private Label brands**
Tax per Litre (2016 ZAR/litre)	0.332*** (0.027)	0.324*** (0.033)	0.270*** (0.030)
Observations	75 408	65 718	9 690
R-squared	0.920	0.925	0.934

Notes: Table 5 shows results of the pass-through regressions using price data from two of the largest three retailers in South Africa. Total includes all taxed fruit drinks and nectars with average price per litre increases after the levy was introduced, and the outcome measure across specifications is price per litre in 2016 ZAR. Tax exempt 100% juices and long-life nectars are excluded from the analysis. Robust standard errors clustered at the province-company-month level in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Source: Author

Pass-through estimates are also larger for smaller packaging sizes (500mls and less) of fruit juice with a pass-through co-efficient estimated which is double the size of larger packaging sizes (750mls or more) with coefficients of 0.552 and 0.243 in Table 5 respectively. This

suggests an increase in the cost of consumption of single servings in comparison to larger, value sizes of fruit juice.

Both producers of sugar-sweetened beverages and retailers have increased the prices of their own fruit juice brands but absorbed some of the cost of the levy with evidence of under-shifted tax for both consumer-branded and private label products. The estimates do however suggest that on average, 20 percent more of the tax is passed on to the consumer, reflected in price increases, for consumer-branded products. This indicates a decline in the relative cost of consumption for private label products.

Excluding new brands added after the introduction of the levy, which accounted for 816 price observations, the regression results in Table 6 indicate that the levy has impacted all brands of fruit juice in the different pricing tiers (discount, average, and premium) with evidence of under-shifted tax across all three tiers. However, the pass-through co-efficients estimated, are largest amongst discount brands with a 73 percent higher price increase per litre for discount in comparison to average priced brands. This suggests a higher tax burden for consumers of discount brands in comparison to average priced brands of fruit juice.

Table 6: Pass-through across different baseline pricing segments

	Total	**Discount priced brands**	**Average priced brands**	**Premium priced brands**
Tax per Litre (2016 ZAR/litre)	0.332*** (0.027)	0.409*** (0.038)	0.236*** (0.031)	0.387*** (0.048)
Observations	75 408	22 331	8 952	43 309
R-squared	0.920	0.955	0.912	0.919

Notes: Table 6 shows results of the pass-through regressions using price data from two of the largest three retailers in South Africa. Total includes all taxed fruit drinks and nectars with average price per litre increases after the levy was introduced, and the outcome measure across specifications is price per litre in 2016 ZAR. Tax exempt 100% juices and long-life nectars are excluded from the analysis. Robust standard errors clustered at the province-company-month level in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Source: Author

Excluding fruit juice sales in liquor stores, the regression results in Table 7, show larger price increases for fruit juice in both convenience and online stores with 0.386 ZAR and 0.337 ZAR more of the levy passed onto consumers in convenience and online stores, on a litre basis, in comparison to fruit juice buyers in grocery stores. The pass-through in these channels is more than twice the magnitude of pass-through in grocery stores and indicates a higher increase in the cost of consumption of fruit juice bought in both convenience and online stores.

Table 7: Pass-through across different retail sales channels

	Total	**Grocery stores**	**Convenience stores**	**Online**
Tax per Litre (2016 ZAR/litre)	0.332*** (0.027)	0.299*** (0.028)	0.685*** (0.079)	0.636** (0.301)
Observations	75 408	65 992	8 810	598
R-squared	0.920	0.919	0.935	0.951

Notes: Table 7 shows results of the pass-through regressions using price data from two of the largest three retailers in South Africa. Total includes all taxed fruit drinks and nectars with average price per litre increases after the levy was introduced, and the outcome measure across specifications is price per litre in 2016 ZAR. Tax exempt 100% juices and long-life nectars are excluded from the analysis. Robust standard errors clustered at the province-company-month level in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Source: Author

The regression results in Table 8, show significant pass-through of the levy to consumer prices of fruit juice in every province of South Africa. The pass-through estimates do however vary significantly with evidence of higher pass-through in Limpopo and the Eastern Cape provinces with, on average, R0.269 and R0.248 more of the levy passed through to consumer prices, on a litre basis for every R1 of tax, in these provinces respectively. The results indicate lower pass-through in KwaZulu Natal and the Northern Cape provinces. Therefore, there has been a higher relative increase in the cost of consumption of fruit juice in Limpopo and the Eastern Cape provinces and a lower relative increase in KwaZulu Natal and the Northern Cape provinces.

Table 8: Pass-through across different provinces

Taxable Products	**Tax per Litre (2016 ZAR/litre)**	**Observations**	**R-squared**
All provinces	0.332*** (0.027)	75 408	0.920
Limpopo	0.601*** (0.102)	4 758	0.940
Eastern Cape	0.580*** (0.072)	9 383	0.917
Gauteng	0.396*** (0.063)	10 442	0.932
North West	0.354*** (0.072)	9 400	0.939
Free State	0.342*** (0.065)	9 372	0.944
Western Cape	0.333*** (0.069)	12 933	0.924
Mpumalanga	0.293*** (0.073)	6 785	0.938
KwaZulu Natal	0.285*** (0.065)	7 326	0.935
Northern Cape	0.243*** (0.091)	5 009	0.951

Notes: Table 8 shows results of the pass-through regressions using price data from two of the largest three retailers in South Africa. Total includes all taxed fruit drinks and nectars with average price per litre increases after the levy was introduced, and the outcome measure across specifications is price per litre in 2016 ZAR. Tax exempt

100% juices and long-life nectars are excluded from the analysis. Robust standard errors clustered at the province-company-month level in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1.

Source: Author

5.4: Changes in the Availability of Products After the Introduction of the Levy

The regression results in Table 9 present estimates of the change in the number of unique juice products sold after the introduction of the levy. The analysis is conducted across all juice categories represented in the sample, and the results show a statistically significant increase in the number of unique tax-exempt products sold in the market after the levy was introduced, illustrated by a 23 percent increase in 100% juice products sold after tax. Simultaneously, there was a significant 11 percent decline in the number of taxed nectars sold after the introduction of the levy which was driven by a 25 percent decline in the number of long-life nectars sold. This result supports H3 (there is an increase in the number of tax-exempt juices sold, and a decrease in the number of taxed juices sold in the market after the introduction of the Health Promotion Levy) and indicates a change in the product portfolio of fruit juices available at retailers in South Africa after the introduction of the levy.

Table 9: Product availability after the introduction of the levy

	Tax-exempt Juice 100%	**Total Taxed juices**	**Taxed Fruit Drinks**	**Taxed Nectars**	**Taxed Long Life Nectars**	**Taxed Combined Nectars**	**Total juices**
Log product count	0.204*** (0.052)	-0.086 (0.056)	-0.022 (0.055)	-0.048 (0.071)	-0.284** (0.130)	-0.121* (0.072)	-0.004 (0.050)
Exponent (Log product count)	1.226	0.918	0.978	0.953	0.753	0.886	0.996
Post-tax percent change	23%***(0.052)	-8% (0.056)	-2% (0.055)	-5% (0.071)	-25%** (0.130)	-11%* (0.072)	0% (0.050)
Observations	1 706	4 282	1 713	1 680	889	2 569	5 988
R-squared	0.677	0.722	0.719	0.695	0.815	0.681	0.738

Notes: Table 9 shows results of the regressions using sales data from two of the largest three retailers in South Africa. The outcome measure across specifications is number of products sold within the pre-tax and post-tax period. Robust standard errors clustered at the province-company-month level in parentheses.

***p < 0.01, **p < 0.05, *p < 0.1.

Source: Author

Chapter 6: DISCUSSION

6.1: Discussion of Findings Related to Price Changes

The statistically significant price per litre increase in taxed fruit juices coupled with a lack of significant increase in tax-exempt fruit juice prices suggest an increased cost of consumption of taxed juices. These findings support the objective of the Health Promotion Levy in raising prices of taxed sugar-sweetened beverages in order to reduce consumption of sugar. Following a relative price increase in taxed fruit juices, one would expect substitution towards tax-exempt juices. In support of this finding, Nielsen data was analysed, represented for short life fruit juices in formal retail South Africa, depicted in Table 10 and found evidence of an 11 percent annual revenue growth for tax-exempt juices, and a 5 percent annual revenue decline for taxed juices (Nielsen, 2019). However, Boulton et al. (2016) studied the sugar content of different fruit juices and 'smoothies' in the United Kingdom, and surprisingly found that of the 203 fruit juices/'smoothies' examined, the taxed juice drinks category had on average 48 percent less sugar per 100ml than the tax-exempt 100% juices and therefore, in order for the Health Promotion Levy to be successful in decreasing consumption of sugar, there is a need to understand the sugar content of both taxed, and tax-exempt, beverages in South Africa.

Table 10*:* Short life fruit juice annual revenue growth

Formal Retail South Africa (Grocery & Convenience)	**Share**	**2018 Revenue**	**2017 Revenue**	**Annual Growth ZAR**	**Annual Growth Percent**
SHORT LIFE FRUIT JUICE	**100%**	**R1 919 565 251**	**R1 817 527 055**	**R102 038 196**	**5.6%**
TAX-EXEMPT JUICES	**69%**	**R1 316 119 560**	**R1 185 008 736**	**R131 110 824**	**11.1%**
FRUIT JUICE - PURE 100%	69%	R1 316 119 560	R1 185 008 736	R131 110 824	11.1%
TAXED JUICES	**31%**	**R603 445 691**	**R632 518 319**	**-R29 072 628**	**-4.6%**
NECTAR	30%	R592 612 805	R622 442 920	-R29 830 115	-4.8%
FRUIT DRINKS <20%	1%	R10 832 886	R10 075 399	R757 487	7.5%

Notes: Table 10 shows the annual short life fruit juice revenue (in ZAR and including VAT) for formal retail South Africa for 2018, March 2018 to February 2019, and 2017, March 2017 to February 2018.

Source: Nielsen, 2019

The variation in estimates across different packaging sizes of fruit juice and the larger price increase estimated for smaller packaging sizes of fruit juice can partly be explained by more frequent pricing promotions occurring on the larger packaging sizes of beverages in retailers. Consumers are generally less aware of price increases on smaller packaging sizes (Taubinsky

& Rees-Jones, 2018) and buyers of larger packaging sizes are assumed to have larger price elasticities of demand, considering that buyers of smaller packaging sizes are willing to pay a higher price per litre for the same product (Russell & Van Walbeek, 2014). However, investigation of pricing elasticities of demand across different packaging sizes of each taxed beverage would help to explain this phenomenon more comprehensively. Either way, the significant price per litre increase on smaller packaging sizes of fruit juices could result in unintended, negative, sugar-sweetened beverage tax outcomes if consumers are aware of the price changes, and adjust their purchasing behaviour towards larger packaging sizes accordingly, and consume more sugar from fruit juice as a result.

The statistically significant increase in the price per litre of taxed fruit juices in grocery stores indicates an increase in the cost of consumption of taxed fruit juices and therefore, one would expect substitution towards purchases of tax-exempt juices in grocery stores as a result. However, price increases were, on average, larger in convenience stores with prices of both taxed, and tax-exempt, juices significantly increasing after the levy. Due to slightly larger price increases on tax-exempt juices, the increase in the cost of consumption of tax-exempt juices was relatively larger than taxed juices in the convenience channel, and therefore the same substitution effect towards more purchases of tax-exempt juices would not be expected in convenience stores. Hence, the levy may not be as effective in reducing consumption of taxed fruit juices amongst buyers of fruit juice in convenience stores, as opposed to buyers in grocery stores. However, further research assessing both the income levels and price elasticities of demand of fruit juice buyers in grocery versus convenience stores, could help to confirm the resultant public health implications surrounding this finding.

6.2: Discussion of Findings Related to Pass-Through

The pass-through findings reflect economic theory that predicts that under an oligopolistic market, taxes can be under-shifted depending on the market structure and demand. For short life nectars and fruit drinks in South Africa, where only 39 percent of the sales are concentrated between three firms (Nielsen, 2019), under shifting is expected. This finding is also consistent with under-shifted tax on fruit juice in France (Berardi et al., 2016; Capacci et al., 2019) and Philadelphia (Cawley, Frisvold, et al., 2018). However, the pass-through co-efficient estimated for fruit juice in South Africa at 0.33 is lower than other countries with a pass-through coefficient of 0.94 for fruit flavoured drinks in France (Berardi et al., 2016) and 0.73 for juice

in Philadelphia (Cawley, Frisvold, et al., 2018). The South African value added tax (VAT) rate increased from 14% to 15% on the same day that the Health Promotion Levy was introduced in South Africa, and the assumption is that retailers accounted for the impact of the VAT increase on consumer disposable incomes and spending in their pricing strategy, and passed through less of the Health Promotion Levy to consumer prices of fruit juices as a result, leading to lower pass-through in South Africa.

Stacey et al. (2019) estimated a pass-through coefficient of 0.68 for high sugar carbonates in South Africa, and results of this study concur with the literature that suggests higher pass-through for carbonated soft drinks in comparison to other non-carbonated sugar-sweetened beverages, including fruit juice and flavoured water (Berardi et al., 2016; Colchero et al., 2015; Silver et al., 2017). A lower pass-through for fruit juice, compared to carbonates, is also expected considering the larger market concentration (Nielsen, 2019) and lower prices for carbonated soft drinks in comparison to fruit juices (Stacey et al., 2019). Significantly higher pricing power is possessed by the carbonated soft drink market leader, in comparison to the fruit juice market leader with the former, owning 91 percent of carbonated soft drink revenues, and the latter, owning 31 percent of short- and long-life fruit juice revenues within the formal retail space in South Africa (Nielsen, 2019). Considering a lower price elasticity for fruit juice in comparison to carbonated soft drinks in South Africa (Stacey et al., 2017), together with the lower-pass through estimated for fruit juices, one would expect the levy to result in smaller reductions in sugar intake from fruit juices in comparison to carbonates and therefore, expect the levy on fruit juices to be less effective in reducing obesity levels in the country in comparison to the levy on carbonated soft drinks. However, Stacey et al.(2017) estimated a positive cross-price elasticity for carbonated soft drinks and fruit juice, indicating that the lower increase in the cost of consumption for fruit juice could incentivize consumer substitution from carbonated soft drinks towards fruit juice. Due to the higher nutritional value of fruit juices, this substitution could provide positive implications for public health. Further research analysing the changes in purchasing behaviour of both fruit juice and carbonated soft drink buyers in South Africa is needed, to provide further evidence to support this finding.

The significantly larger pass-through co-efficients estimated for fruit drinks in contrast to nectars is understandable, considering that legislation in South Africa requires a much higher fruit juice content for fruit nectars, as opposed to fruit drinks. For example, according to legislation, an apple fruit nectar needs to contain up to 50% fruit juice, whereas all fruit drinks in contrast, only need to contain 6% fruit juice with the rest of the product consisting of sugar

with or without, the addition of water (South African Fruit Juice Association, 2019). Therefore, it is plausible for one to assume higher raw material costs to produce a fruit nectar in contrast to a fruit drink, and a higher degree of reformulation of fruit nectars in order to reduce the tax burden for the producer as a result. However, further research is required to understand the extent of product reformulation across different categories of fruit juice after the introduction of the levy. Should further research confirm this finding, there would be important implications for public health because the increased cost of consumption for fruit drinks in comparison to fruit nectars should incentivise substitution towards fruit nectars. As fruit nectars contain a potentially lower sugar content after increased product reformulation, the total reduction in sugar consumption across both fruit drink and nectars could be potentially larger. However, it would also be important to understand the nature of the product reformulation because many producers reformulate products by substituting sugar with non-nutritive sweeteners, and these sweeteners also increase the risk of developing obesity and non-communicable diseases (Pepino, 2015) and therefore, this reformulation could have little impact on both obesity and non-communicable disease prevalence in the country.

The larger pass-through on smaller packaging sizes (500mls or less) is consistent with findings from both global and local sugar sweetened beverage pass-through studies (Colchero et al., 2015; Falbe et al., 2015; Rueh, 2017; Stacey et al., 2019). As previously discussed, this finding is to be expected, however, the increased cost of consumption of single servings of fruit juice in comparison to bulk servings, could potentially result in substitution towards purchasing more bulk containers of fruit juice. This substitution could potentially impact the amount of fruit juice and sugar consumed per day, which would ultimately impact government's ability to reduce the prevalence of obesity and non-communicable disease in the country.

The observed slightly larger pass-through on discount brands in comparison to average priced brands, concurs with findings that higher baseline prices are associated with lower price increases following tax increases (Kenkel, 2005), and is consistent with a pass-through study on tobacco in the United States, where the pass-through was higher for discount cigarette brands as the demand for discount cigarettes were more price inelastic than premium cigarette brands (Chiou & Muehlegger, 2014). This result was influenced by substitution towards discount cigarettes after tobacco tax changes. Further research assessing both the substitution effects of a sugar-sweetened beverage tax in South Africa and the price elasticities of demand for fruit juice categories and pricing segments, would help to further explain this result. However, what is reassuring is that both the pass-through estimates and sugar content of both

premium and discount brands are larger than the average priced brands, with discount brands containing 60 percent more sugar, on average, than an average priced brand, and the premium brands containing on average 45 percent more sugar. Higher pass-through on beverages with a higher sugar content is comforting, considering that the levy acts as a public health 'tool' that addresses excess consumption of sugar.

The larger pass-through in convenience stores is synonymous with findings in Colorado (Cawley, Crain, et al., 2018) and is expected, with the consumer's lower price sensitivity levels demonstrated, in convenience stores (Broda et al., 2009). Similarly, the higher pass-through in online stores is understandable, considering that online buyers tend to have higher income levels (Swinyard & Smith, 2003). However, the larger price increases in both online and convenience stores have an ability to influence purchasing behaviour by consumers, and the slightly higher price increase estimated for tax-exempt fruit juices in convenience stores limits the ability of desired substitution from taxed towards tax-exempt fruit juice purchases.

Higher pass-through in consumer branded products could imply that both manufacturers and retailers raise prices of consumer branded products after a tax is introduced, or that retailers absorb more of the tax on their own brands in comparison with the amount of tax that the manufacturers absorb on their consumer branded products. However, further research analysing manufacturer-to-retailer prices as well as consumer prices could help to dissect the total tax burden by producer, retailer, and consumer, as well as the pricing power possessed by both manufacturers and retailers in the country.

Heterogeneous pass-through across provinces is consistent with findings in global studies, particularly in the United States, where pass-through is impacted by the distance of the taxed jurisdiction to a nearby jurisdiction either not subject to the tax, or with a lower tax rate (Harding et al., 2012). Interestingly, in South Africa, pass-through is estimated to be higher in the two provinces with the highest poverty levels namely, Limpopo and the Eastern Cape (Stats SA, 2019a). Pass-through estimates are lowest in KwaZulu Natal and the Northern Cape, the provinces with the fourth and seventh lowest poverty levels in the country, but with the second and third lowest baseline prices for fruit juices. One would therefore assume that the sugar-sweetened beverage tax has provided a greater health opportunity for poorer fruit juice buyers in South Africa, following larger price increases, and higher responsiveness to price changes (Allcott et al., 2019a), however Stacey et al. (2017) found that the household expenditure on fruit juice actually increases with increased income in South Africa. Poorer consumers might

not purchase fruit juice and therefore further research is required to understand the different income levels of fruit juice consumers across the different provinces, and their pricing elasticities of demand, in order to accurately inform arguments made against the regressive nature of sugar-sweetened beverage taxes.

6.3: Discussion of Findings Related to Products Available for Sale

The findings of product availability after the introduction of the levy concur with Cawley, Frisvold, et al. (2018) that the availability of tax-exempt products increase after the introduction of a sugar-sweetened beverage tax. The increase in the number of 100% juice products sold in the market confirms expectations that manufacturers adjust new product development spend in order to minimise tax losses (Blecher, 2015) and retailers adjust in-store product portfolios. This finding also corresponds with announcements made by Camilla Osbourne, Coca Cola's Head of communications, in 2019, which stated that Coca-Cola had changed its original recipe and had reduced the sugar content of its portfolio by 26 percent as a result of the Health Promotion Levy in South Africa. They also launched low kilojoule and no-sugar alternative beverages, and shifted their marketing investments towards these lower sugar alternatives, accordingly (Pace, 2019).

The higher percentage decline in fruit nectars in comparison to fruit drinks corresponds with the assumption that more fruit nectars were reformulated or delisted after the introduction of the levy, as a result of higher raw material costs. However, further research analysing the degree of reformulation across different categories of fruit juice would be required to confirm this assumption.

6.4: Research Limitations

The following research limitations are applicable to this study:

a) Based on the literature review, a 'difference-in-difference' approach allows researchers to determine causality between sugar-sweetened beverage taxes and changes in price. However, South Africa's levy is a national tax and producers generally sell both taxed and tax-exempt beverages. The test for causality would require a non-substitute product to be used as a control group, however this study was unable to directly test for causality as there was no access to the relevant data.

b) The study did not have access to the sugar content of products for the time period before the sugar-sweetened beverage tax was introduced and did not have access to the sugar content of all individual products after the sugar-sweetened beverage tax was introduced. However, a further study comparing the sugar content of products before and after the introduction of the tax could inform findings regarding producer product reformulation as a result of the tax.

c) The study had access to data including consumer prices, however, a further study using both manufacturer-to-retailer and consumer prices could provide valuable information regarding the tax burden on both producers and retailers.

d) Access to data extended only to formal retail stores. However, a study using data from the informal retail sector could produce significantly different results and help to inform regression arguments.

e) In South Africa in 2019, the largest annual growth in food and beverage income was derived from catering services, and takeaway and fast food outlets (Stats SA, 2019b). A study using data from the on-consumption channel could produce significantly different results to this study and highlight any changes in the place of purchase as a result of the tax.

f) The dataset utilised did not provide detail regarding the sugar content of beverages before, and after, the introduction of the levy, and therefore could not assess the reformulation of different fruit juice categories. A study analysing the reformulation of fruit drinks and nectars after the introduction of the levy could provide important insight into the changes in sugar consumption from fruit drink and nectars, by these consumers.

Chapter 7: RESEARCH CONCLUSIONS

7.1: Summary of Results

Using administrative store-level scanner data, the study has found evidence that the Health Promotion Levy has, on average, resulted in significant price increases of taxed fruit juices with no significant price increases of tax-exempt fruit juices after the introduction of the levy. Furthermore, this paper finds that there has been a significant increase in the number of tax-exempt fruit juice products sold after the introduction of the levy. The increased cost of consumption of taxed fruit juices supports the objective of the Health Promotion Levy in raising prices of taxed sugar-sweetened beverages to reduce excessive consumption of sugar, and the increase in tax-exempt products sold incentivises consumers to purchase tax-exempt products. Therefore, both results support policy attempts to reduce obesity and non-communicable diseases in South Africa.

The pass-through estimates obtained indicate that both fruit juice producers and consumers share the burden of the tax. Lower pass-through estimates are expected in South Africa where a one percent increase in the value added tax was implemented on the same day that the levy was introduced, and lower pass-through estimates are expected for non-carbonated sugar-sweetened beverages. The results of the pass-through estimates for fruit juice in South Africa are plausible as they are lower than the estimates for carbonated soft drinks in South Africa, and lower than pass-through estimates for fruit juices in both France and Philadelphia.

Clear evidence is found for the effect of different categories of fruit juice on tax pass-through with fruit drinks experiencing the highest level of tax pass-through. The larger price increase of fruit drinks presents an opportunity for consumers to adjust their purchasing behaviour towards purchasing more fruit nectars to reduce their tax burden. South African legislation requires fruit nectars to contain a higher fruit juice content in contrast to fruit drinks, and due to the assumed higher raw material costs of fruit nectars and potentially larger product reformulation as a result of the tax, substitution towards fruit nectars could support government attempts to reduce excessive consumption of sugar and obesity levels within the country.

Clear evidence of the effect of different packaging sizes on tax pass-through is produced for fruit juice with bulk packaging sizes experiencing the lowest level of tax pass-through. The larger price increases on smaller packaging sizes presents an opportunity for consumers to adjust their purchasing behaviour towards purchasing more bulk packaging sizes to reduce their

tax burden. Subsequently, the potential substitution towards bulk packaging presents a potential threat to government's objective of reducing excessive consumption of sugar.

Evidence indicating higher price increases of tax-exempt fruit juices in convenience stores and therefore, a higher cost of consumption of these beverages, limits government ability to influence consumer substitution towards tax-exempt juices within the convenience channel. Lower pass-through in grocery stores, where the bulk of fruit juice purchases are made, also limits government ability to achieve the desired reduction in purchases of taxed juices.

Nevertheless, evidence suggesting larger pass-through for both premium and discount brands in contrast to average priced brands, together with higher sugar content of both premium and discount branded products, indicates an increase in the cost of consumption of fruit juices with a higher sugar content. This finding supports the ability of the levy to reduce excessive consumption of sugar.

The study provides evidence of larger pass-through in two provinces with the highest levels of poverty in South Africa. It would be worthwhile to extend the analysis to include the estimation of price elasticities of demand of fruit juice consumers with different household income levels so as to understand the impact of the levy on different socio-economic groups. The nature of the South African sugar-sweetened beverage tax, being a national tax, eliminates the application of a 'difference-in difference' approach as means of concluding causality between the levy and the price increases of sugar-sweetened beverages. However, despite these limitations, the results provide a useful starting point in informing policymakers on sugar-sweetened beverage taxes, and ingredient-based taxes.

7.2: Contribution to Literature

The findings offer support for the literature regarding raised prices of taxed products after the introduction of a sugar-sweetened beverage tax, and this report offers a deeper understanding of pass-through across untested pricing determinants within a South African context, such as retailer place of purchase and consumer branded, versus retailer, own brands. The discovery that significantly more tax-exempt fruit juices were sold after the introduction of the levy is vital in understanding the impact of an ingredient-based sugar-sweetened beverage tax. This research has paved a path for future quantitative studies to assess the casual relationship between the levy, and prices of sugar-sweetened beverages in South Africa, and to assess the impact on sugar consumption.

7.3: Sugar-sweetened Beverage Producer and Retailer Implications

Apart from contributing to the existing body of literature and providing important information for policymakers, the findings of this report provide valuable information to sugar-sweetened beverage producers and retailers. The differential pass-through across fruit juice categories, packaging sizes, and retailer channels, should assist producers and retailers in developing pricing strategies.

Chapter 8: DIRECTIONS FOR FUTURE RESEARCH

To make a determination of the overall effectiveness of the Health Promotion Levy in South Africa, one needs to understand the impact of the levy on sugar-sweetened beverage purchases *after* its introduction. As the levy was only introduced eighteen months ago, no such published research currently exists in South Africa. However, researchers should consider incorporating analysis of substitution to other beverages, both alcoholic and non-alcoholic, as well as different food categories, in the wake of the tax coming into effect. Furthermore, an assessment of the reformulation of different taxed beverages after the introduction of the levy is required to accurately assess the change in sugar consumption.

The results from this study have shown that the prices of taxed fruit juice have increased as a result of the levy. However, to understand the impact of the price increases on purchasing behaviour and consumption, we need to understand the price elasticity of demand of *different* sugar-sweetened beverages across different pricing determinants, such as packaging sizes, baseline pricing of brands, retailer channels, and provinces.

Future research should consider incorporating electronic point-of-sale data for the fruit juice category at retailers in South Africa, and in other African countries where a sugar-sweetened beverage tax has not been implemented, so as to use these latter countries as a control group to determine causality between the levy and price increases.

Future research should also consider incorporating pricing data in the informal retail sector in South Africa to understand the tax burden across consumers of different socio-economic levels.

REFERENCES

Allcott, H., Lockwood, B. B., & Taubinsky, D. (2019a). *Regressive sin taxes, with an application to the optimal soda tax*. (No. 25841) NBER Working Paper, National Bureau of Economic Research, Masschusetts. Retrieved from http://www.nber.org/papers/w25841

Allcott, H., Lockwood, B. B., & Taubinsky, D. (2019b). Should we tax soda? An overview of theory and evidence. *Journal of Economic Perspectives*, *33*(3), 22. Retrieved from https://benlockwood.com/papers/Allcott_Lockwood_Taubinsky_SodaTaxesJEP.pdf%0Ahttps://sites.google.com/site/allcott/research.

Allen, K., Pearson-Stuttard, J., Hooton, W., Diggle, P., Capewell, S., & O'Flaherty, M. (2015). Potential of trans fats policies to reduce socioeconomic inequalities in mortality from coronary heart disease in England: Cost effectiveness modelling study. *BMJ Online*, *351*, 1–10. https://doi.org/10.1136/bmj.h4583

Alvarado, M., Unwin, N., Sharp, S. J., Hambleton, I., Murphy, M. M., Samuels, T. A., … Adams, J. (2019). Assessing the impact of the Barbados sugar-sweetened beverage tax on beverage sales: An observational study. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(13), 1–12. https://doi.org/10.1186/s12966-019-0776-7

Andreyeva, T., Chaloupka, F. J., & Brownell, K. D. (2011). Estimating the potential of taxes on sugar-sweetened beverages to reduce consumption and generate revenue. *Preventive Medicine*, *52*, 413–416. https://doi.org/10.1016/j.ypmed.2011.03.013

Bahl, R., Bird, R., & Walker, M. B. (2003). The uneasy case against discriminatory excise taxation: Soft drink taxes in Ireland. *Public Finance Review*, *31*(5), 510–533. https://doi.org/10.1177/1091142103253753

Ball, D. W. (2006). Concentration scales for sugar solutions. *Journal of Chemical Education*, *83*(10), 1489–1491. https://doi.org/10.1021/ed083p1489

Barzel, Y. (1976). An alternative approach to the analysis of taxation. *Journal of Political Economy*, *84*(6), 1177–1197.

Basu, S., & Madsen, K. A. (2017). Effectiveness and equity of sugar-sweetened beverage taxation. *PLOS Medicine*, *14*(6), e1002327.

https://doi.org/10.1371/journal.pmed.1002327

Basu, S., Vellakkal, S., Agrawal, S., Stuckler, D., Popkin, B., & Ebrahim, S. (2014). Averting obesity and Type 2 Diabetes in India through sugar sweetened beverage taxation: An economic-epidemiologic modeling study. *PLoS Medicine*, *11*(1), 1–13. https://doi.org/10.1371/journal.pmed.1001582

Benade, J., & Essop, F. (2017). Introduction of "Sugar Tax" in South Africa: Placebo or panacea to curb the onset of cardio-metabolic diseases? *Journal of the South African Heart Association*, *14*(3).

Berardi, N., Sevestre, P., Tepaut, M., & Vigneron, A. (2016). The impact of a 'soda tax' on prices: evidence from French micro data. *Applied Economics*, *48*(41), 3976–3994.

Bergman, U. M., & Hansen, N. L. (2012). *Are excise taxes on beverages fully passed through to prices? The Danish evidence*. (Working paper) University of Copenhagen. Retrieved from https://www.researchgate.net/publication/268429840_Are_Excise_Taxes_on_Beverages_Fully_Passed_Through_to_Prices_The_Danish_Evidence

Bielenia-Grajewska, M. (2019). Threats to research validity. In B. B. Frey (Ed.), *The Sage encyclopedia of educational research, measurement, and evaluation* (pp. 1697–1698). Thousand Oaks, CA: Sage.

Black, P. A., & Mohamed, A. I. (2006). "Sin" taxes and poor households: Unanticipated effects. *South African Journal of Economics*, *74*(1), 131–136. https://doi.org/10.1111/j.1813-6982.2006.00053.x

Blecher, E. (2015). Taxes on tobacco, alcohol and sugar sweetened beverages: Linkages and lessons learned. *Social Science and Medicine*, *136–137*, 175–179. https://doi.org/10.1016/j.socscimed.2015.05.022

Blecher, E., Liber, A. C., Drope, J. M., Nguyen, B., & Stoklosa, M. (2017). Global trends in the affordability of sugar-sweetened beverages, 1990-2016. *Preventing Chronic Disease, 14*(E37), 160406. https://doi.org/10.5888/pcd14.160406

Bollinger, B. K., & Sexton, S. (2018). *Local excise taxes, sticky prices, and spillovers: Evidence from Berkeley's Soda Tax*. (Unpublished paper) Duke University. https://doi.org/10.2139/ssrn.3087966

Bonnet, C., & Réquillart, V. (2013). Tax incidence with strategic firms in the soft drink market. *Journal of Public Economics*, *106*, 77–88. https://doi.org/10.1016/j.jpubeco.2013.06.010

Bouchery, E. E., Harwood, H. J., Sacks, J. J., Simon, C. J., & Brewer, R. D. (2011). Economic costs of excessive alcohol consumption in the U.S., 2006. *American Journal of Preventive Medicine*, *41*(5), 516–524. https://doi.org/10.1016/j.amepre.2011.06.045

Boulton, J., Hashem, K. M., Jenner, K. H., Lloyd-Williams, F., Bromley, H., & Capewell, S. (2016). How much sugar is hidden in drinks marketed to children? A survey of fruit juices, juice drinks and smoothies. *BMJ Open*, *6*(3), 1–5. https://doi.org/10.1136/bmjopen-2015-010330

Briggs, A. D. M., Kehlbacher, A., Tiffin, R., & Scarborough, P. (2016). Simulating the impact on health of internalising the cost of carbon in food prices combined with a tax on sugar-sweetened beverages. *BMC Public Health*, *16*(107), 1–14. https://doi.org/10.1186/s12889-016-2723-8

Broda, C., Leibtag, E., & Weinstein, D. E. (2009). The role of prices in measuring the poor's living standards. *Journal of Economic Perspectives*, *23*(2), 77–97.

Bryman, A., & Bell, E. (2007). *Business research methods* (2nd ed.). Oxford; New York: Oxford University Press.

Burrell, N., & Gross, C. (2018). Purpose of qualitative research. In M. Allen (Ed.), *The Sage encyclopedia of communication research methods* (pp. 1378–1380). Thousand Oaks, CA: Sage. https://doi.org/10.4135/9781483381411.n476

Byrne, D. (2017). Data analysis and interpretation. In *Research project planner* (pp. 1–41). London, UK: Sage. https://doi.org/10.4135/9781526408570

Capacci, S., Allais, O., Bonnet, C., & Mazzocchi, M. (2019). The impact of the French soda tax on prices, purchases and tastes: An ex post evaluation. *PLOS ONE*, *14*(10), 1–22. https://doi.org/10.1371/journal.pone.0223196

Castelló, J. V., & Casasnovas, G. L. (2019). Impact of SSB taxes on sales. *Economics & Human Biology*, *36*(100821), 1–12. https://doi.org/10.1016/j.ehb.2019.100821

Cawley, J., Crain, C., Frisvold, D., Jones, D., Thank, W., Hulbert, A., … Arndt, R. (2018). *The pass-through of the largest tax on sugar-sweetened beverages: The case of Boulder,*

Colorado. (No. 25050) NBER Working Paper, National Bureau of Economic Research, Masschusetts. Retrieved from http://www.nber.org/papers/w25050

Cawley, J., & Frisvold, D. (2015). *The incidence of taxes on sugar-sweetened beverages: The case of Berkeley California*. (No. 21465) NBER Working Paper, National Bureau of Economic Research, Masschusetts. Retrieved from http://www.nber.org/papers/w21465

Cawley, J., Frisvold, D., Hill, A., & Jones, D. (2018). *The impact of the Philadelphia beverage tax on prices and product availability*. (No. 24990) NBER Working Paper, National Bureau of Economic Research, Masschusetts. Retrieved from http://www.nber.org/papers/w24990

Cawley, J., Willage, B., & Frisvold, D. (2018). Pass-through of a tax on sugar-sweetened beverages at the Philadelphia International Airport. *JAMA: The Journal of the Americal Medical Association*, *319*(3), 305–306.

Chiou, L., & Muehlegger, E. (2010). *Consumer response to cigarette excise tax changes*. (RWP10-020) HKS Faculty Research Working Paper Series, Harvard Kennedy School.

Chiou, L., & Muehlegger, E. (2014). Consumers response to cigarette excise tax changes. *National Tax Journal*, *67*(3), 621–650.

Colchero, M. A., J., R.-D., Popkin, B. M., & Ng, S. W. (2017). In Mexico, evidence of sustained consumer response two years after implementing a sugar-sweetened beverage tax. *Health Affairs*, *36*(3), 564–571. https://doi.org/10.1377/hlthaff.2016.1231

Colchero, M. A., Molina, M., & Guerrero-López, C. M. (2017). After Mexico implemented a tax, purchases of sugar-sweetened beverages decreased and water increased: Difference by place of residence, household homposition and income level. *The Journal of Nutrition*, *147*(8), 1552–1557. https://doi.org/10.3945/jn.117.251892

Colchero, M. A., Salgado, J. C., Unar-Munguía, M., Molina, M., Ng, S., & Rivera-Dommarco, J. A. (2015). Changes in prices after an excise tax to sweetened sugar beverages was implemented in Mexico: Evidence from Urban Areas. *PLOS ONE*, *10*(12), 1–12. https://doi.org/10.1371/journal.pone.0144408

Connelly, R., Playford, C. J., Gayle, V., & Dibben, C. (2016). The role of administrative data in the big data revolution in social science research. *Social Science Research*, *59*, 1–12. https://doi.org/10.1016/j.ssresearch.2016.04.015

Cuneo, A., Milberg, S. J., Benavente, J. M., & Palacios-Fenech, J. (2015). The growth of private label brands: A worldwide phenomenon? *Journal of International Marketing*, *23*(1), 72–90. https://doi.org/10.1509/jim.14.0036

DeCicca, P., Kenkel, D., & Liu, F. (2013). Excise tax avoidance: The case of state cigarette taxes. *Journal of Health Economics*, *32*(6), 1130–1141. https://doi.org/10.1016/j.jhealeco.2013.08.005

Delipalla, S., & O'Donnell, O. (2001). Estimating tax incidence, market power and market conduct: The European cigarette industry. *International Journal of Industrial Organization*, *19*, 885–908.

Department of Health South Africa. (2018). *South African experience in introducing sugar taxation*. Retrieved from https://www.who.int/nutrition/events/2018-fpgh-workshop-nutrition-against-ncd-16nov-presentation-LindiweMakubalo-SouthAfrica.pdf?ua=1

Duffey, K. J., Gordon-Larsen, P., Shikany, J. M., Guilkey, D., Jacobs, D., & Popkin, B. M. (2010). Food price and diet and health outcomes. *Archives of Internal Medicine*, *170*(5), 420–426. https://doi.org/10.1001/archinternmed.2009.545

Edwards, R. D. (2011). Commentary: Soda taxes, obesity, and the shifty behavior of consumers. *Preventive Medicine*, *52*, 417–418. https://doi.org/10.1016/j.ypmed.2011.04.011

Espinosa, J., & Evans, W. N. (2013). Excise taxes, tax incidence and the flight to quality: Evidence from scanner data. *Public Finance Review*, *41*(2), 147–176. https://doi.org/10.1177/1091142112460724

Etile, F., & Sharma, A. (2015). Do high consumers of sugar-sweetened beverages respond differently to price changes? Finite mixture IV-TOBIT approach. *Health Economics*, *24*(11), 1147–1163. https://doi.org/10.1002/hec

European Competitiveness and Sustainable Industrial Policy Consortium. (2014). *Food taxes and their impact on competitiveness in the agri-food sector*. Final report, July 12. Rotterdam, The Netherlands: ECORYS. Retrieved from https://publications.europa.eu/en/publication-detail/-/publication/878937f9-daee-4db6-a14a-a76d0d3efcbb/language-en

Falbe, J., Rojas, N., Grummon, A. H., & Madsen, K. A. (2015). Higher retail prices of sugar-

sweetened beverages 3 months after implementation of an excise tax in Berkeley, California. *American Journal of Public Health*, *105*(11), 2194–2201. https://doi.org/10.2105/AJPH.2015.302881

Falbe, J., Thompson, H. R., Becker, C. M., Rojas, N., McCulloch, C. E., & Madsen, K. A. (2016). Impact of the Berkeley excise tax on sugar-sweetened beverage consumption. *American Journal of Public Health*, *106*(10), 1865–1871. https://doi.org/10.2105/AJPH.2016.303362

Finkelstein, E. A., Zhen, C., Bilger, M., Nonnemaker, J., Farooqui, A. M., & Todd, J. E. (2013). Implications of a sugar-sweetened beverage (SSB) tax when substitutions to non-beverage items are considered. *Journal of Health Economics*, *32*(1), 219–239. https://doi.org/10.1016/j.jhealeco.2012.10.005

Fletcher, J. M., Frisvold, D. E., & Tefft, N. (2010). The effects of soft drink taxes on child and adolescent consumption and weight outcomes. *Journal of Public Economics*, *94*(11–12), 967–974. https://doi.org/10.1016/j.jpubeco.2010.09.005

Fooks, G. J., Williams, S., Box, G., & Sacks, G. (2019). Corporations' use and misuse of evidence to influence health policy: A case study of sugar-sweetened beverage taxation. *Globalization and Health*, *15*(1), 1–20. https://doi.org/10.1186/s12992-019-0495-5

Francis, N., Marron, D. B., & Rueben, K. S. (2016). *The pros and cons of taxing sweetened beverages based on sugar content*. Research report, Urban Institute, Washington, DC. https://doi.org/10.2139/ssrn.2947716

Goncalves, J., & Dos Santos, J. P. (2019). *Brown sugar, how come you taste so good? The impact of a soda tax on prices and consumption*. (Working paper) Nova School of Business and Economics. Retrieved from http://ieb.ub.edu/wp-content/uploads/2019/05/WSTAX19_Santos.pdf

Griffith, R., Connell, M. O., Smith, K., & Stroud, R. (2019). *The evidence on the effects of soft drink taxes*. The Institute for Fiscal Studies. Retrieved from https://www.ifs.org.uk/publications/14382

Grogger, J. (2017). Soda taxes and the prices of sodas and other drinks: Evidence from Mexico. *American Journal of Agricultural Economics*, *99*(2), 481–498. https://doi.org/10.1093/ajae/aax024

Hanson, A., & Sullivan, R. S. (2009). The incidence of tobacco taxation: Evidence from geographic micro-Level data. *National Tax Journal*, *62*(4), 677–698. https://doi.org/10.2139/ssrn.1268305

Harding, M., Leibtag, E., & Lovenheim, M. F. (2012). The heterogeneous geographic and socioeconomic incidence of cigarette taxes: Evidence from Nielsen Homescan Data. *American Economic Journal: Economic Policy*, *4*(4), 169–198. https://doi.org/10.1257/pol.4.4.169

Harris, J. E. (1987). The 1983 Increase in the Federal Cigarette Excise Tax. *Tax Policy and the Economy*, *1*, 87–111. https://doi.org/10.1086/tpe.1.20061764

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. *Evidence Based Nursing*, *18*(3), 66–67. https://doi.org/10.1136/eb-2015-102129

Heutel, G. (2011). *Optimal policy instruments for externality-producing durable goods under time inconsistency*. (No. 17083) NBER Working Paper, National Bureau of Economic Research, Masschusetts. Retrieved from http://www.nber.org/papers/w17083

Hu, F. B. (2013). Resolved: There is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. *Obesity Reviews*, *14*, 606–619. https://doi.org/10.1111/obr.12040

Johnson, T. (1978). Additional evidence on the effects of alternative taxes on cigarette prices. *Journal of Political Economy*, *86*(2), 325–328.

Kachersky, L. (2011). Reduce content or raise price? The impact of persuasion knowledge and unit price increase tactics on retailer and product brand attitudes. *Journal of Retailing*, *87*(4), 479–488. https://doi.org/10.1016/j.jretai.2011.08.001

Kenkel, D. S. (2005). Are alcohol tax hikes fully passed through to prices? Evidence from Alaska. *American Economic Review*, *95*(2), 273–277. https://doi.org/10.1257/000282805774670284

Kumar, R. (2011). *Research methodology: A step-by-step guide for beginners* (3rd ed.). Thousand Oaks, CA: Sage.

Lee, B. Y. (2018, July 2). Thinking about implementing a soda tax? Here is a “how to” guide. *Forbes*. Retrieved from https://www.forbes.com/sites/brucelee/2018/07/02/thinking-about-implementing-a-soda-tax-here-is-a-how-to-guide/#6014e3bd54ad

Leedy, P., & Ormrod, J. (2016). *Practical research planning and design* (12th ed.). New York, NY: Pearson Education.

Leider, J., Pipito, A. A., Li, Y., Bontu, A., Boylan, E. E., & Powell, L. M. (2018, September). The impact of the Cook County, Illinois, sweetened beverage tax on prices, 2017. *Illinois Prevention Research Centre*, 1–2. Retrieved from https://illinoisprc.org/wp-content/uploads/2018/09/Tax-Pass-Through_Cook-County-IL-Illinois-PRC-Brief-No.-105-Sept-2018.pdf

Linegar, D., & Van Walbeek, C. (2015). *The effects of cigarette taxes on prices: A dynamic analysis of pass-through in South Africa*. (Unpublished paper).

Lloyd, P., & MacLaren, D. (2019). Should we tax sugar and if so how? *Australian Economic Review*, *52*(1), 19–40. https://doi.org/10.1111/1467-8462.12299

Long, J. S., & Ervin, L. H. (2000). Using heteroscedasticity consistent standard errors in the Linear Regression Model. *The American Statistician*, *54*(3), 217–224. https://doi.org/10.1080/00031305.2000.10474549

Ludbrook, A. (2019). Fiscal measures to promote healthier choices: An economic perspective on price-based interventions. *Public Health*, *169*(0), 180–187. https://doi.org/10.1016/j.puhe.2019.02.008

Malik, V. S., & Hu, F. B. (2011). Sugar-sweetened beverages and health: Where does the evidence stand? *American Journal of Clinical Nutrition*, *94*(5), 1161–1162. https://doi.org/10.3945/ajcn.111.025676.Am

Manyema, M., Veerman, L. J., Chola, L., Tugendhaft, A., Sartorius, B., Labadarios, D., & Hofman, K. J. (2014). The potential impact of a 20% tax on sugar-sweetened beverages on obesity in South African adults: A mathematical model. *PLOS ONE*, *9*(8), 1–10. https://doi.org/10.1371/journal.pone.0105287

Manyema, M., Veerman, L. J., Tugendhaft, A., Labadarios, D., & Hofman, K. J. (2016). Modelling the potential impact of a sugar-sweetened beverage tax on stroke mortality, costs and health-adjusted life years in South Africa. *BMC Public Health*, *16*(1), 1–10. https://doi.org/10.1186/s12889-016-3085-y

MarketLine. (2018). Food & grocery retail in South Africa, (November), 1–31. Retrieved from https://advantage-marketline-

com.oxfordbrookes.idm.oclc.org/Analysis/ViewasPDF/germany-food-grocery-retail-72039

McLoughlin, J.-A., Little, F., Mazok, C., Parry, C., & London, L. (2013). Prevalence of and associations with Papsak Wine consumption among farm workers in the Western Cape Province, South Africa. *Journal of Studies on Alcohol and Drugs*, *74*(6), 879–888. Retrieved from https://www.jsad.com/doi/abs/10.15288/jsad.2013.74.879

Morton, A. (2016, July 11). South Africa outlines 20% sugar tax on sodas. *Just-Drinks*. Retrieved from https://www.just-drinks.com/news/south-africa-outlines-20-sugar-tax-on-sodas_id120746.aspx

Mouton, J. (2001). *How to succeed in your master's & doctoral studies*. Cape Town, SA: Van Schaik.

Nakamura, R., Langenberg, C., Mirelman, A. J., Cuadrado, C., Silva-Illanes, N., Dunstan, J., & Suhrcke, M. (2018). Evaluating the 2014 sugar-sweetened beverage tax in Chile: An observational study in urban areas. *PLOS Medicine*, *15*(7), 1–23. https://doi.org/10.1371/journal.pmed.1002596

Nakhimovsky, S. S., Feigl, A. B., Avila, C., O'Sullivan, G., MacGregor-Skinner, E., & Spranca, M. (2016). Taxes on sugar-sweetened beverages to reduce overweight and obesity in middle-income countries: A systematic review. *PLoS ONE*, *11*(9), 1–22. https://doi.org/10.1371/journal.pone.0163358

National Treasury. (2016). *Taxation of sugar sweetened beverages*. Policy Paper, Economics Tax Analysis Chief Directorate, Department of National Treasury, South Africa. Retrieved from http://www.treasury.gov.za/public comments/Sugar sweetened beverages/POLICY PAPER AND PROPOSALS ON THE TAXATION OF SUGAR SWEETENED BEVERAGES-8 JULY 2016.pdf

National Treasury. (2019). Revenue trends and tax policy. In *Budget review* (pp. 35–46). Pretoria, SA: The Treasury. Retrieved from http://www.treasury.gov.za/documents/national budget/2019/review/Chapter 4.pdf

Ngwema, S. (2018, October 5). Extent of market concentration in South Africa's product market. *Competition Commission Media Statement*. Retrieved from http://www.compcom.co.za/wp-content/uploads/2017/01/Competition-Commission-

prosecutes-banks-currency-traders-for-collusion-15-Feb-2016.pdf [Accessed 25 March 2019]

Nielsen. (2019). *Fruit juice EPOS data*. Data supplied to researcher (not publically avaiilable).

O'Leary, Z. (2007). Hypothesis/hypothetico-deductive method. In *The Social Science Jargon Buster* (pp. 123–125). London, UK: Sage. Retrieved from http://methods.sagepub.com/book/the-social-science-jargon-buster/n61.xml

Olivier, P. C. (2017). *The sugar tax debate in South Africa: A content analysis of print advertisements*. (MBA Research Report) Graduate School of Business, University of Cape Town, South Africa.

Pace, A. (2019, May 23). Coca-Cola SA changes original recipe. *Cape{town}etc*. Retrieved from https://www.capetownetc.com/news/coca-cola-sa-changes-original-recipe/

Pepino, M. Y. (2015). Metabolic effects of non-nutritive sweeteners. *Physiology and Behavior*, *152*, 450–455. https://doi.org/10.1016/j.physbeh.2015.06.024

Pigou, A. (1920). *The economics of welfare*. London, UK: Macmillan.

Powell, L. M., & Chaloupka, F. J. (2009). Food prices and obesity: Evidence and policy implications for taxes and subsidies. *Milbank Quarterly*, *87*(1), 229–257. Retrieved from http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed9&NEWS=N&AN=2009120777

Quirmbach, D., Cornelsen, L., Jebb, S. A., Marteau, T., & Smith, R. (2018). Effect of increasing the price of sugar-sweetened beverages on alcoholic beverage purchases: An economic analysis of sales data. *Journal of Epidemiology and Community Health*, Advanced online, 1-7. https://doi.org/10.1136/jech-2017-209791

Rasmussen, B., Sweeny, K., & Sheehan, P. (2017). *Economic costs of absenteeism, presenteeism and early retirement due to ill health: A focus on South Africa*. Report to the Chamber of Commerce, Victoria Institute of Strategic Economic Studies, Victoria University, Melbourne, Australia.

Retief, E. (2015, September). Sugar tax: Essential for South Africa's health? *Moneyweb's Tax Breaks,* 6–7.

Roache, S. A., & Gostin, L. O. (2017). The untapped power of soda taxes: Incentivizing consumers, generating revenue, and altering corporate behavior. *International Journal of Health Policy and Management, 6*(9), 489–493. https://doi.org/10.15171/ijhpm.2017.69

Ronquest-Ross, L. C., Vink, N., & Sigge, G. O. (2015). Food consumption changes in South Africa since 1994. *South African Journal of Science, 111*(9–10), 64–75. https://doi.org/10.17159/sajs.2015/20140354

Rueh, J. (2017). *Impact after implementation of an excise tax on cookies: Evidence from Mexico*. (MPhil Thesis) Department of Health Management and Health Economics, Faculty of Medicine, University of Oslo.

Russell, C., & Van Walbeek, C. (2014). *Who pays alcohol taxes? An analysis of alcohol tax pass-through using South African data*. Paper prepared for the Postgraduate Student Conference, Department of Economics, Universit of Stellebosch, South Africa. Retrieved from https://www.ekon.sun.ac.za/postgradconference2015/russell_full-text.pdf

Sacks, G., Veerman, J., Moodie, M., & Swinburn, B. (2011). "Traffic-light" nutrition labelling and "junk-food" tax: a modelled comparison of cost-effectiveness for obesity prevention. *International Journal of Obesity*, *35*, 1001–1009.

Salie, M., Strauss, N., Davids, M., Smit, Y., Boshoff, S., & Bruwer, J.-P. (2014). The effects of sin tax on the profitability of SMME convenience stores in the Cape Metropole. *Topclass Journal of Business Management and Innovations*, *1*(2), 25–36. Retrieved from http://www.topclassglobaljournals.org

Sassi, F., Belloni, A., Mirelman, A. J., Suhrcke, M., Thomas, A., Salti, N., … Nugent, R. (2018). Equity impacts of price policies to promote healthy behaviours. *The Lancet, 391*(10134), 2059–2070. https://doi.org/10.1016/S0140-6736(18)30531-2

Sheiham, A. (2001). Dietary effects on dental diseases. *Public Health Nutrition, 4*(2B), 569–591. https://doi.org/10.1079/PHN2001142

Silver, L. D., Ng, S. W., Ryan-ibarra, S., Taillie, L. S., Induni, M., Miles, D. R., … Popkin, B. M. (2017). Changes in prices, sales, consumer spending, and beverage consumption one year after a tax on sugar-sweetened beverages in Berkeley, California, US: A before-and-after study. *PLoS Medicine*, *14*(4), 1–19.

https://doi.org/10.1371/journal.pmed.1002283

South Africa's most popular retailers: Shoprite vs Pick n Pay vs Spar vs Checkers. (2018, October 27). *BusinessTech*, p. 1. Retrieved from https://businesstech.co.za/news/business/279067/south-africas-most-popular-retailers-shoprite-vs-pick-n-pay-vs-spar-vs-checkers/

South African Fruit Juice Association. (2019). *Frequently Asked Questions (FAQ)*. Retrieved from https://www.safja.co.za/safja-faq.html#13

South African Revenue Services. (2019). *Health Promotion Levy on sugary beverages*. Retrieved from https://www.sars.gov.za/ClientSegments/Customs-Excise/Excise/Pages/Health Promotion Levy on Sugary Beverages.aspx

Stacey, N. (2017). *The Health Promotion Levy*. [Presentation] Priceless SA, School of Public Health, University of Witwatersrand, South Africa. Retrieved from http://pmg-assets.s3-website-eu-west-1.amazonaws.com/171128priceless.pdf

Stacey, N., Mudara, C., Wen Ng, S., van Walbeek, C., Hofman, K., & Edoka, I. (2019). Sugar-based beverage taxes and beverage prices: Evidence from South Africa's Health Promotion Levy. *Social Science & Medicine*, *238*(112465), 1–8. https://doi.org/10.1016/j.socscimed.2019.112465

Stacey, N., Tugendhaft, A., & Hofman, K. (2017). Sugary beverage taxation in South Africa: Household expenditure, demand system elasticities, and policy implications. *Preventive Medicine*, *105*, S26–S31. https://doi.org/10.1016/j.ypmed.2017.05.026

Stats SA. (2018). *Mortality and causes of death in South Africa, 2016: Findings from death notification*. (P0309.30) Statistical release, Statistics South Africa. https://doi.org/Statistical release P0309.3

Stats SA. (2019a). *Five facts about poverty in South Africa*. Retrieved from http://www.statssa.gov.za/?p=12075

Stats SA. (2019b). *Food and beverages*. Retrieved from http://www.statssa.gov.za/?page_id=1856&PPN=P6420&SCH=7452

Sullivan, R. S., & Dutkowsky, D. H. (2012). The effect of cigarette taxation on prices: An empirical analysis using local-level data. *Public Finance Review*, *40*(6), 687–711. https://doi.org/10.1177/1091142112442742

Swinyard, W. R., & Smith, S. M. (2003). Why people (don't) shop online: A lifestyle study of the Internet consumer. *Psychology and Marketing*, *20*(7), 567–597. https://doi.org/10.1002/mar.10087

Taubinsky, D., & Rees-Jones, A. (2018). Attention variation and welfare: Theory and evidence from a tax salience experiment. *Review of Economic Studies*, *85*(4), 2462–2496. https://doi.org/10.1093/restud/rdx069

Vecino-Ortiz, A. I., & Arroyo-Ariza, D. (2018). A tax on sugar sweetened beverages in Colombia: Estimating the impact on overweight and obesity prevalence across socio economic levels. *Social Science and Medicine*, *209*(40), 111–116. https://doi.org/10.1016/j.socscimed.2018.05.043

Vellios, N., Van Walbeek, C., & Ross, H. (2019). Illicit cigarette trade in South Africa: 2002-2017. *Tobacco Control*, 1–9. https://doi.org/10.1136/tobaccocontrol-2018-054798

Walliman, N. (2011). Quantitative data analysis. In *Social Research Methods* (pp. 110–128). Thousand Oaks, CA: Sage. https://doi.org/10.4135/9781849209939.n10

Warren, G. W., Alberg, A. J., Kraft, A. S., & Cummings, K. M. (2014). The health consequences of smoking-50 years of progress. *Surgeon General's Report and Cancer Care*, *120*(13), 1914–1916. https://doi.org/10.1002/cncr.28695

Wennlo, J. (2018). *Sugar taxes impact on childhood obesity: A systematic literature study*. (Unpublished Thesis).

Wooldridge, J. (2013). Regression analysis with cross-sectional data. In *Introductory Econometrics: A modern approach 5th edition* (pp. 1–910). Cengage Learning. https://doi.org/10.4324/9781351140768-8

World Health Organization. (2014, September). Reducing consumption of sugar-sweetened beverages to reduce the risk of unhealthy weight gain in adults. *E-Library of Evidence for Nutrition Actions (ELENA)*, 3–6. Retrieved from https://www.who.int/elena/bbc/ssbs_adult_weight/en/

World Health Organization. (2017). *Taxes on sugary drinks: Why do it?* Retrieved from https://apps.who.int/iris/bitstream/handle/10665/260253/WHO-NMH-PND-16.5Rev.1-eng.pdf;jsessionid=4460546230F262780703A11C38D7AB62?sequence=1

World Health Organization. (2018, February 16). Obesity and overweight. *Factsheet*.

Retrieved from https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight

World Health Organization. (2019, February 11). Reducing consumption of sugar-sweetened beverages to reduce the risk of childhood overweight and obesity. *E-Library of Evidence for Nutrition Actions (ELENA)*. Retrieved from https://www.who.int/elena/titles/ssbs_childhood_obesity/en/

Wright, A., Smith, K. E., & Hellowell, M. (2017). Policy lessons from health taxes: A systematic review of empirical studies. *BMC Public Health*, *17*(583), 1–14. https://doi.org/10.1186/s12889-017-4497-z

Young, D., & Bielinska-Kwapisz, A. (2002). Alcohol taxes and beverage prices. *National Tax Journal*, *1*, 3–73.

Zhong, Y., Auchincloss, A. H., Lee, B. K., & Kanter, G. P. (2018). The short-term impacts of the Philadelphia beverage tax on beverage consumption. *American Journal of Preventive Medicine*, *55*(1), 26–34. https://doi.org/10.1016/j.amepre.2018.02.017

APPENDICES

Appendix 1. Descriptive Statistics

Table 10: Descriptive statistics of sample

	Tax-exempt products	Taxable Products				Total Products
	Juice 100%	Total	Fruit Drink	Nectar	Long Life Nectars	Total
Average Real Price per litre (Pre-tax)	R20.44	R16.65	R17.19	R13.73	R18.19	R18.18
Average Real Price per litre (Post-tax)	R20.95	R17.64	R18.77	R14.27	R17.87	R19.08
Post-tax Price per litre difference	R0.51	R0.99	R1.59	R0.54	-R0.32	R0.90
Post-tax Price per litre difference %	3%	6%	9%	4%	-2%	5%
Brands (Number)	45	81	60	28	15	99
Flavours (Minimum number)	24	28	26	16	14	31
Products (Number) - Pre-tax	396	724	436	177	111	1 120
Products (Number) - Post-tax	429	714	430	199	85	1 143
Post-tax products difference	33	-10	-6	22	-26	23
Post-tax products difference %	8%	-1%	-1%	12%	-23%	2%
Real Revenue (share) - Pre-tax	45%	55%	39%	12%	4%	100%
Real Revenue (share) - Post-tax	50%	50%	36%	11%	3%	100%
Real Revenue (share) - difference	5%	-5%	-3%	-1%	-1%	0%
Sales volumes (Litres) - Pre-tax	39%	61%	41%	14%	5%	100%
Sales volumes (Litres) - Post-tax	45%	55%	39%	13%	4%	100%
Observations	131 909	183 051	114 523	39 097	29 431	314 960
Pack size (Volume sold in units)						
Single serving (500ml or less)	40 572 219	41 711 207	33 939 020	7 771 485	702	82 283 426
Bulk (750ml or more)	51 905 444	69 595 562	46 176 068	14 494 415	8 925 079	121 501 006
Pack size (Real Revenue share)						
Single serving (500ml or less)	29%	24%	28%	20%	0%	26%
Bulk (750ml or more)	71%	76%	72%	80%	100%	74%
Pack size (Real Revenue change) - post tax						
All packaging sizes	**14%**	**-6%**	**-4%**	**-5%**	**-30%**	3%
Single serving (500ml or less)	46%	56%	56%	54%	81%	51%
Bulk (750ml or more)	4%	-21%	-21%	-16%	-30%	-10%
Retailer channel (Number of observations)						
Grocery	116 817	162 688	103 077	35 284	24 327	279 505
Convenience	13 682	18 114	10 592	3 454	4 068	31 796
Online	1 408	2 218	843	339	1 036	3 626
Liquor	2	31	11	20		33
Retailer channel (Volume sold in units)						
Grocery	89 133 042	107 232 274	77 255 517	21 577 915	8 398 842	196 365 316
Convenience	3 235 803	3 723 439	2 698 902	623 982	400 555	6 959 242
Online	108 765	350 549	160 643	63 522	126 384	459 314

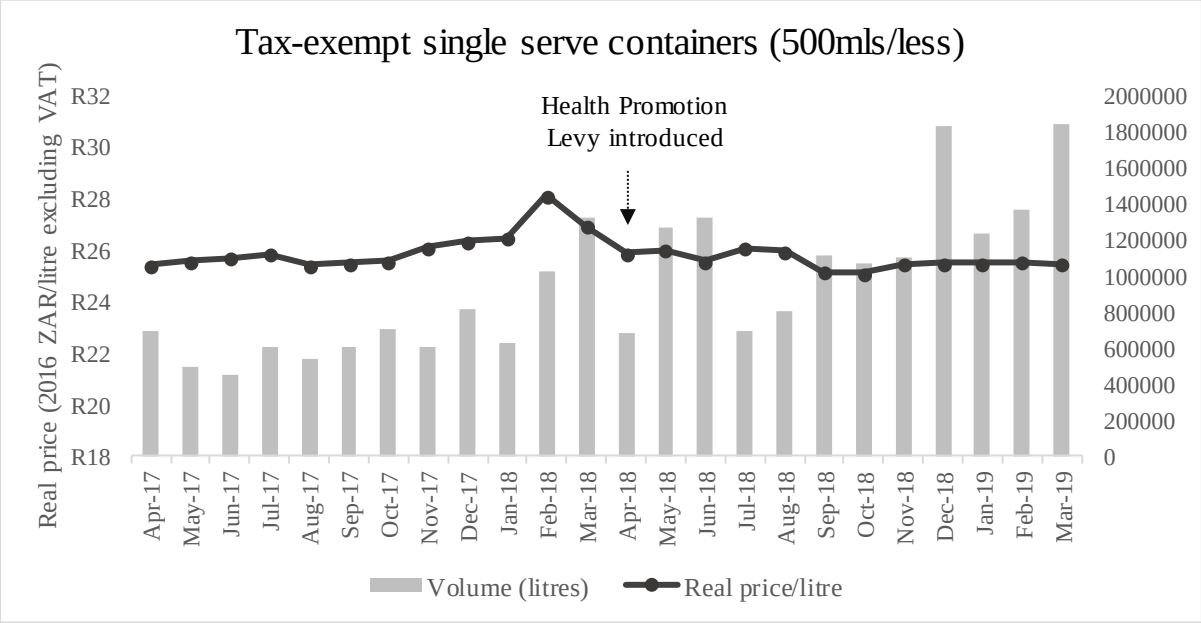
Liquor	53	507	26	481		560
Retailer channel (Revenue share)						
Grocery	96.5%	96.3%	96.3%	97.1%	93.9%	96.4%
Convenience	3.4%	3.4%	3.5%	2.6%	4.4%	3.4%
Online	0.1%	0.4%	0.2%	0.3%	1.8%	0.2%
Liquor	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Province (Number of observations)						
Gauteng	20 791	26 772	15 918	5 341	5 513	47 563
Western Cape	18 047	27 831	17 248	6 634	3 949	45 878
Free State	17 350	22 738	13 097	5 564	4 077	40 088
North West	18 071	21 084	13 299	4 564	3 221	39 155
Eastern Cape	12 370	21 731	14 227	4 742	2 762	34 101
KwaZulu-Natal	10 660	19 605	12 841	3 436	3 328	30 265
Mpumalanga	13 901	16 266	10 218	3 282	2 766	30 167
Northern Cape	10 973	14 483	9 622	3 204	1 657	25 456
Limpopo	9 746	12 541	8 053	2 330	2 158	22 287
Province (Volume sold in units)						
Gauteng	28 218 092	29 083 916	22 472 519	3 314 376	3 297 021	57 302 008
Western Cape	19 958 659	23 561 565	13 739 247	8 253 812	1 568 506	43 520 224
KwaZulu-Natal	10 654 844	15 692 048	10 906 010	3 831 548	954 490	26 346 892
Eastern Cape	8 169 922	10 004 972	7 228 013	2 041 416	735 543	18 174 894
Limpopo	6 605 605	8 227 373	6 813 283	957 718	456 372	14 832 978
Mpumalanga	5 879 362	6 712 593	5 285 919	757 529	669 145	12 591 955
Free State	5 448 958	6 919 090	4 691 782	1 648 787	578 521	12 368 048
North West	5 114 677	6 922 472	5 608 735	845 920	467 817	12 037 149
Northern Cape	2 427 544	4 182 740	3 369 580	614 794	198 366	6 610 284
Province (Revenue share)						
Gauteng	33%	27%	30%	16%	33%	30%
Western Cape	21%	22%	16%	41%	16%	21%
KwaZulu-Natal	11%	14%	14%	16%	12%	13%
Eastern Cape	8%	8%	8%	8%	11%	8%
Limpopo	7%	7%	8%	4%	5%	7%
Mpumalanga	6%	6%	7%	3%	8%	6%
North West	6%	6%	7%	4%	6%	6%
Free State	6%	6%	6%	6%	7%	6%
Northern Cape	3%	3%	4%	2%	2%	3%
Province (Pre-tax Baseline pricing)						
Gauteng	21.26	17.53	18.11	14.80	18.45	19.10
Mpumalanga	20.86	17.44	17.81	15.20	18.60	18.93
North West	20.75	17.24	17.93	14.53	18.09	18.80
Limpopo	20.50	17.56	17.80	15.22	18.95	18.78
Free State	20.31	16.92	17.61	13.53	19.12	18.34
Western Cape	20.96	16.08	17.08	12.36	17.49	17.92
KwaZulu-Natal	19.49	16.50	17.11	13.39	17.08	17.51
Northern Cape	19.49	15.47	15.61	12.86	19.02	17.18
Eastern Cape	19.19	15.20	15.60	12.82	16.85	16.60

Notes: Table 11 shows descriptive statistics for the price data from two of South Africa's three biggest retailers. Prices are in per-litre terms and reflect real prices adjusted to December 2016 using monthly Consumer Price index data and excluding value added tax. Similarly, Real revenue has been adjusted to December 2016 using monthly Consumer Price index data and excluding value added tax.

Source: Author

Appendix 2. Trended Fruit Juice Sales (Volumes) and Average Prices

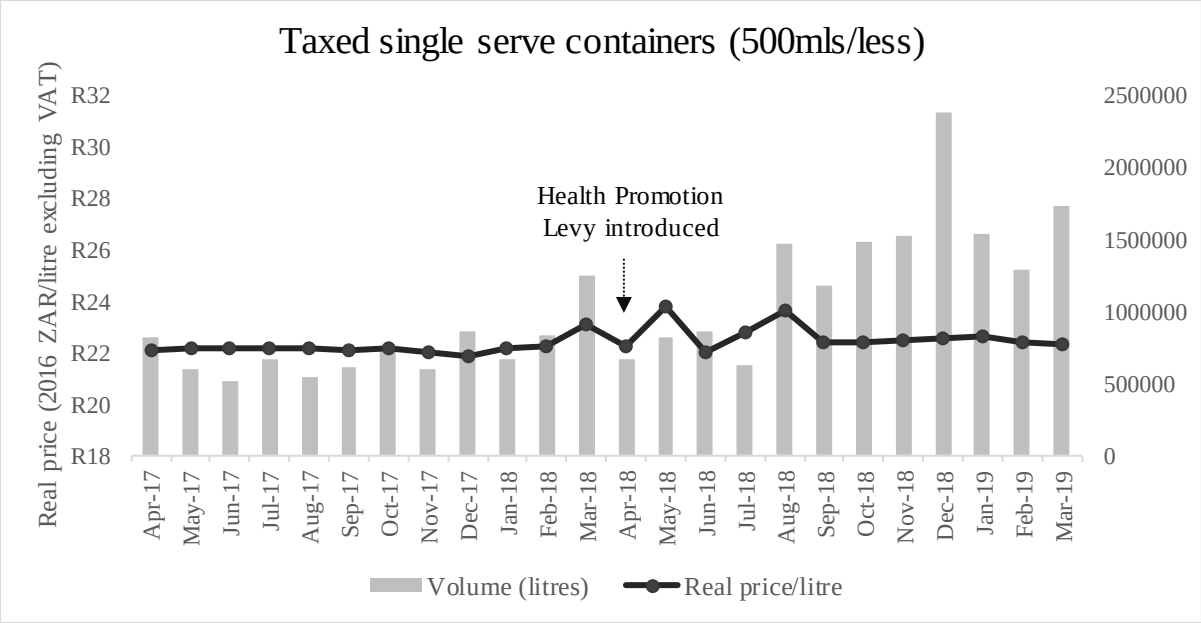
Figure 8: Tax-exempt single serve fruit juice prices versus sales



Notes: Figure 8 shows the average prices, adjusted to December 2016 prices and excluding value added tax, and total litres sold of tax-exempt fruit juices in single serve containers in two of South Africa's largest retailers.

Source: Author

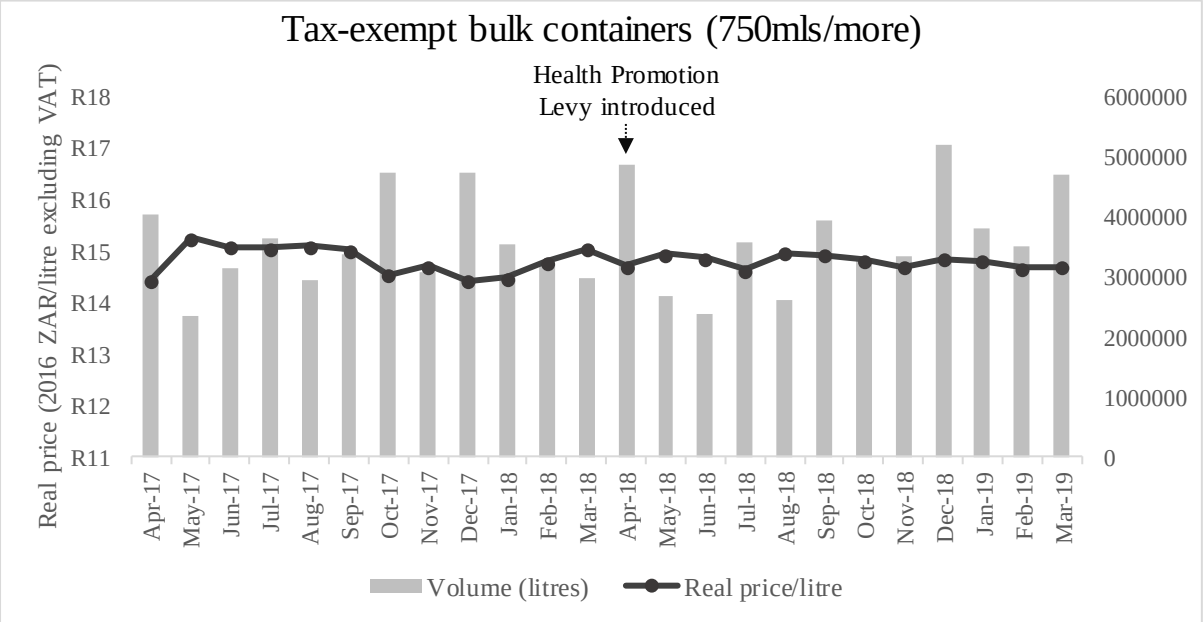
Figure 9: Taxed single serve fruit juice prices versus sales



Notes: Figure 9 shows the average prices, adjusted to December 2016 prices and excluding value added tax, and total litres sold of taxed fruit juices in single serve containers in two of South Africa's largest retailers.

Source: Author

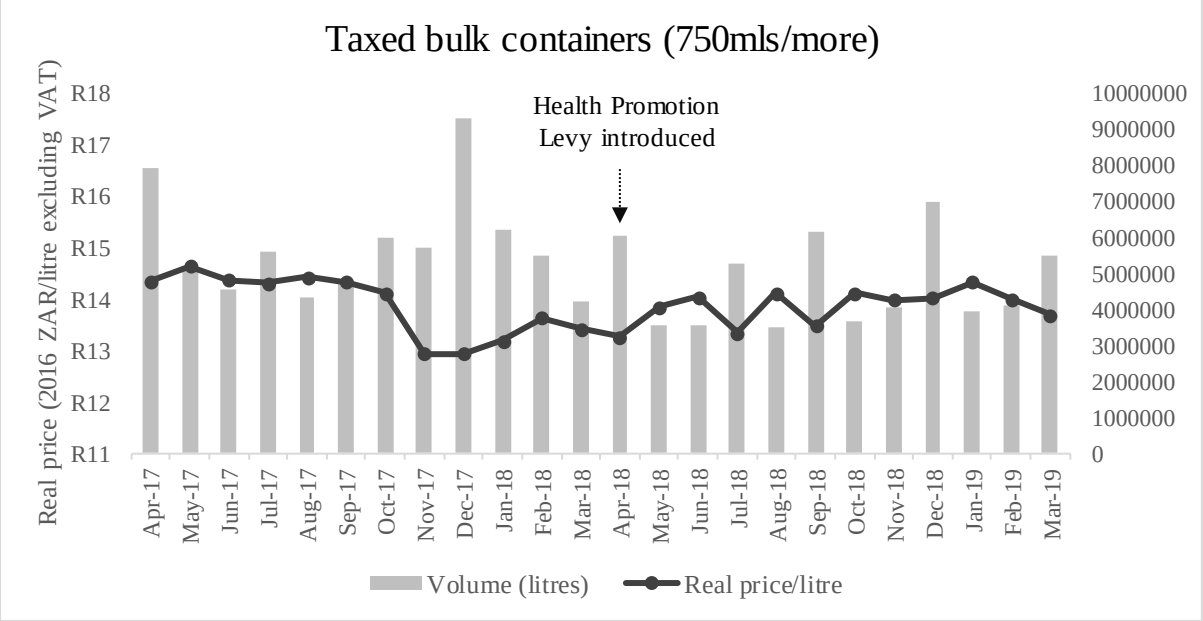
Figure 10: Tax-exempt bulk fruit juice prices versus sales



Notes: Figure10 shows the average prices, adjusted to December 2016 prices and excluding value added tax, and total litres sold of tax-exempt fruit juices in bulk containers in two of South Africa's largest retailers.

Source: Author

Figure 11: Taxed bulk fruit juice prices versus sales



Notes: Figure11 shows the average prices, adjusted to December 2016 prices and excluding value added tax, and total litres sold of taxed fruit juices in bulk containers in two of South Africa's largest retailers.

Source: Author