A micro-analysis of the influence of retail promotions on the healthiness of breakfast cereal purchases

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In loving memory of my grandfather, I dedicate this thesis to him, who taught me to work hard for the things that I aspire to achieve. I would also like to dedicate this thesis to my loving parents for their everlasting encouragement, love and patience.

Author's declaration

This thesis is submitted in fulfilment of the requirements for the degree of Doctor of Philosophy at Bournemouth University, United Kingdom. I declare that this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that this thesis has not been previously or concurrently submitted, either in whole or in part, for any other qualification at Bournemouth University or other institutions.

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Publications and Conference Presentations

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Abstract

An unhealthy diet is associated with obesity, negative health outcomes and increasing public costs such as health care expenses and unemployment. A lower socio-economic status population has a higher incidence of obesity, yet it is these groups that are most susceptible to food marketing tools. One common tool are retail promotions such as temporary price reductions and multi-buy offers. This study investigates retail purchases made under different promotion types through the lens of the retailer and the consumer. The aim of the study is to examine the influence of retail promotions on sales and purchases of healthy and less healthy breakfast cereals. Further, it investigates the role of retail promotions on improving the healthiness of purchases and the evidence whether promotions can encourage healthier eating patterns. In order to achieve the above-mentioned aim, the study employs a sample from Kantar Worldpanel scanner data using Scotland as a case study across breakfast cereal purchases. The primary contribution of this study is adding knowledge to the food economics literature on the role of retail promotions and the main novelty is that the study investigates across different retail promotion types and their influence on sales as well as purchases. The study examines price and volume promotions across the perspective of retailers, consumers, and policy. Further, this study uses the UK FSA nutrient profiling score to assess the healthiness of each product in the dataset linking less healthy dietary patterns to ultra-processed foods analysing the whole food category breakfast cereals.

The research results have a number of policy implications that can help shape consumer's diets for the better through improving the market environment by promoting healthier products. The results indicate that retail promotions are more likely to be applied to less healthy breakfast cereal products across both price and volume promotions used by the retailers. Moreover, the results reveal that both retail promotions increase purchases and therefore, the consumption across households. Further, both retail promotion types decrease the overall healthiness of households encouraging the healthiest and least healthy households to purchase unhealthier breakfast cereals – therefore retail promotions impact the diet of consumers and might be one factor contributing to the obesity crisis among adults and children. Strict regulations through the UK government are necessary to have a stronger impact with policy implications identifying practical strategies and enabling healthier food shopping which will help improve consumer diets in the long term. The results clearly show the potential for promotions in a pro-health strategy and one policy approach might be to restrict retail promotions on less healthy products and at the same time encourage price reductions and multi-buy offers on healthy products only. The thesis informs on the debate of the role of different retail promotion types in unhealthy eating and provides evidence on the potential for price discounting to promote healthier eating patterns, particularly among socio-economic groups exhibiting the poorest diets.

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List of Abbreviations and Acronyms

Although most of the abbreviations are explained when they are used for the first time in the text, they are also listed here.

Acronym	Expression
BMI	Body mass index
BOGOF	Buy-one-get-one-free
COVID-19	Coronavirus Disease
DCMS	Department for Digital, Culture, Media and Sport
DEFRA	Department for Environment, Food and Rural Affairs
DHSC	Department of Health and Social Care
FAO	The Food and Agriculture Organisation of the United Nations
FMLOGIT	Fractional multinomial logit
FOPL	Front of pack labelling
FSS	Food Standards Scotland
HFSS	Products high in fat, salt and sugar
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary least squares
PHE	Public Health England
QR	Quantile regression
RTEC	Ready-to-eat-cereals
SACN	Scientific Advisory Committee on Nutrition
SES	Socio-economic status
SIMD	Scottish Index of Multiple Deprivation
SSB	Sugar-sweetened beverages
TPR	Temporary Price Reduction
UK FSA	Food Standard Agency Nutrient Profiling model
UPF	Ultra-processed foods
VIF	Variance Inflation Factor
WHO	World Health Organisation

Chapter 1

1. Introduction and overview of research

1.1. Research background

An unhealthy diet is associated with obesity and is clearly linked to negative health outcomes and increasing costs such as expenses in health care (Afshin et al. 2019). Health care costs for an overweight population range between 2 per cent and 8 per cent of total health expenditure across various countries. High obesity rates not only pose a greater health burden on economies but also negatively impact on the levels of educational attainment achieved by the overweight and obese children and reduces employment and employability (OECD 2019b).

These health outcomes are correlated with differences in behaviour across socio-economic groups. These groups are defined through a socio-economic status (SES), which is often based on indicators such as the income, education and employment of a person or a household. For example, lower socio-economic groups have a higher incidence of obesity as well as heart diseases, strokes, some cancers and hypertension (OECD 2019a). The importance of health but also the inequalities across SES groups have been underlined by the COVID-19 pandemic. The high obesity rates and diet-related diseases contributed to the strong impact of the COVID-19 crisis on the UK and the poorest in society are impacted even stronger because obesity is more prevalent in the lowest income groups compared to the highest (NFS 2020). Paradoxically along with the rise in the obesity rates there is an emerging trend of household food and nutritional insecurity in some developed countries, ranging from 8 -20 per cent of the population (Pollard and Booth 2019). The Food and Agricultural Organisation of the United Nations (FAO) defines food insecurity as a “lack of regular access to enough safe and nutritious food for normal growth and development and an active and healthy life. This may be due to unavailability of food and/or lack of resources to obtain food” (FAO 2019). The co-existence of obesity and food insecurity shows that overconsumption and undernutrition can occur at the same time within a

household and within an individual throughout the life course. Evidence shows that in the United Kingdom the obesity rate is about 27 per cent, but at the same time food insecurity is high – about 11 per cent of British households cannot ensure nutrient-rich food consumption. Those with a lower socio-economic background eat the most unhealthily and are more susceptible to food marketing compared to higher SES groups (Hemmingsson 2018). Income plays a crucial role among lower SES groups considering that healthy foods are often more expensive. In the United Kingdom, an average 10.6 per cent of household expenditure was spent on food in 2017/18. While the lowest decile invests about 20 per cent of their income on food and drinks, the percentage spent on food was 6 per cent among the highest decile (UK Government 2020a).

One way to increase health of the population is through a better diet. A variety of policy measures some of which are aimed specifically at the lower socio-economic groups, often use educational policies. Common policy instruments used in OECD countries aim to improve quality of dietary choices of individuals stressing the importance of personal responsibility but also through the use of information on e.g., food labels and national dietary guidelines. However, there is evidence for the need of policy instruments that go beyond educational approaches.

Another way to tackle the obesity crisis is implementing policies that restrict the use of marketing strategies to decrease overconsumption of less healthy food. While the reasons for the worldwide obesity problem are complex and diet plays a crucial role, the fact that consumers purchase the majority of their food from supermarkets in many countries suggests that marketing behaviour may play a role in fashioning the diet. Families in the United Kingdom spend about 80 per cent of their food budget (that is eaten at home) in supermarkets and 40 per cent of all expenditure on food and drinks consumed at home have been bought under a promotion (Smithson et al. 2015). The link between marketing, poor diet and nutritional intake has been researched by economist for health, behaviour and public finance reasons. The food environment includes marketing strategies which try to influence food purchases of consumers and signals them what to purchase through addressing availability, affordability, convenience, and desirability of various foods. One common marketing tool used for food products are supermarket promotions at the retailer in-store such as price reductions and multi-buy offers. Price is a key determinant of food choice among consumers, especially among low-income households who are more sensitive to for example price-lowering strategies such as price promotions and generic/retailer-owned brands. Therefore, these strategies can represent important policy targets when trying to improve nutrition and reduce inequities among the population (Zorbas et al. 2019). The role of price promotions has recently been recognised by the UK and Scottish government proposing regulatory policies to reduce the use of retail promotions on less healthy foods, including banning “buy one get one free” deal promotions on unhealthy food, as well as junk food adverts before 9 pm for the entire UK. This has been introduced as part of a strategic plan to improve the diet and weight of the population, especially targeting childhood obesity (Tedstone et al. 2015; Coker et al 2019; UK Government 2020).

This thesis investigates the role of supermarket promotions on products sold and purchased in the breakfast cereal category. An important meal of the food consumed at home is breakfast, which often consists of breakfast cereals. Breakfast cereals can influence the healthiness of the population when eating appropriate and healthy breakfast cereals regularly but can lead to a higher risk of obesity in case of overconsumption of less healthy products. Moreover, the prevalence of obesity and skipping of breakfast was higher among people with a low socio-economic background (Hulshof et al. 2003). Combining the role of supermarket promotions with the importance of breakfast cereals consumption in the British diet, it underlines the relevance of this research topic because it has a crucial impact on all breakfast cereal consumers in the United Kingdom. Therefore, this thesis examines the influence of supermarket promotions on (less) healthy breakfast cereals sold in retailers and purchased by consumers. One of the key contributions of this study is the differentiation between in-store supermarket promotion types such as price and volume promotions. Moreover, it includes the degree of healthiness for each individual product in the analysis. Does the use of different supermarket promotions in retailing lead to more unhealthy purchases made by the consumers? This study investigates purchases made under different promotion types through the lens of the retailer but also from a consumer's point of view.

The results of this study will have implications for (i) practitioners who apply promotional strategies to their consumers in a supermarket based on product and household characteristics and (ii) academics who are interested in the motives and impacts of promotions on purchase behaviour and (iii) policy makers. Moreover, the results that will be reported in this thesis, will inform the debate on the role of promotions in healthy and unhealthy eating and provide evidence on the potential for price discounting to promote healthier eating, particularly among socio-economic groups exhibiting the poorest diets.

1.2. Research aim and questions

The overarching aim of this thesis is to investigate the influence of supermarket promotions on the sales[1] and the purchases of healthy and less healthy breakfast cereal. It examines the role of retail promotions on influencing diets and the evidence whether promotions can encourage healthier eating patterns. This thesis will focus on three themes, each concerning different perspectives of retail promotions on food purchases and applying separate econometric methods. Further, it will include policy implications, and partially includes findings of an official published OECD report about socio-economic determinants of food choices and the issue of policy targeting written by the author of the thesis (Placzek 2021). As a result, the main research aim will be approached by using three main

[1] Throughout this thesis the word "sales" is used as a synonym of 'value of purchases', i.e., to describe products sold/ revenue of retailer and not as sales in terms of an applied promotion.

questions that investigate a different perspective of the research data. This is broken down into three research questions and the thesis aims to answer the following questions:

OVERALL: What is the role of retail promotions on food choices? Do promotions currently encourage healthier or unhealthier diets?

RQ1: What type of breakfast cereal products are more likely to be promoted in a supermarket?

RQ2: What factors (such as promotion types, socio-economic characteristics of households, product characteristics) influence the purchases of breakfast cereals made by households?

RQ3: What type of policies have the potential to encourage healthier breakfast cereal purchases?

The first empirical chapter explores the relationship between supply-side strategies from the retailers and various product, shop and household characteristics of products sold under promotion in the breakfast cereal market, especially comparing across brand and health status of a product. This first research question focuses on investigating product-level data from Kantar Worldpanel scanner data however aiming at describing the supply side of these promotional strategies among retailers. The analysis deals with retailers using promotional offers to sell products to their consumers and analyses product level data looking at certain product characteristics that increase the probability that a product is sold under a certain promotion type. The following empirical chapter will look at the demand side using the household as a unit of analysis investigating the purchases made by a household instead of products sold by the retailer. The second analysis looks at the scanner data from the consumer's perspective and how promotional offers influence purchases made by households and enables to look at specific socio-economic characteristics in the analysis. The third chapter examines the role of different retail promotion types on encouraging healthier breakfast cereal purchases. The analysis investigates the healthiness of purchases and which factors encourage less healthy household purchases. Further, it includes an overview of policies that encourage healthier purchases among consumers based on recent UK and Scottish Government plans.

It is important to highlight the role of data in this study. This study makes use of household purchase data, which provides information on retail promotions as part of a marketing strategy of purchases of healthy and less healthy food groups, it is vital to mention that the prevalence of retail promotions among household purchases is a combination of both the frequency of these promotions on foods but also the consumer's response to them. The combined effect of retail promotions is based on the consumer purchasing promoted products, which indicates whether the promotion has been successfull. However, the data does not include information on the frequency and duration of

promotions, marketing intensity, competitive reactions from other retailers or manufacturers, and shopper characteristics such as deal-proneness (Taillie et al. 2017). However, this study tries to shine light on both sides of the equation: the promotions offered by the retailers but also the purchases made by the households, both based on the Kantar Worldpanel purchase data from 2015.

Overall, this thesis investigates the Kantar Worldpanel dataset from two perspectives: the retailer applying the promotions to certain products in their stores and the consumers purchasing these promotions that have been offered by the retailer. A great novelty of this research is the use of a household panel dataset which is analysed through the lens of the retailer (supply side) as well as the consumer (demand side).

1.3. Research objectives

In order to answer the outlined research questions, this research intends to achieve the following objectives.

1. To identify what breakfast cereals are offered by retailers under promotion. Further, to provide insights into the application to supermarket promotions across healthiness and brand status of the products. Additionally, the research aims to compare the applied promotions by retailers across different promotion types and across promotion intensity.

2. To identify how retail promotions influence the purchases of healthy and less healthy products made by households. To address this objective, the study will categorise the products into healthy and unhealthy food using the UK FSA Nutrient profiling model. Moreover, to gain insights on the purchases made across specific household characteristics. Additionally, the research aims to compare the influence of promotion types on purchases made by households of healthy and less healthy products of various socio-economic groups. This links the promotion types and the promotion intensity to the actual food purchases of various socio-economic groups.

3. To investigate the role of price and volume retail promotions on the healthiness of households purchasing breakfast cereals. Furthermore, to examine what policies might be successful in encouraging healthier purchases in the retail environment. Additionally, to conclude targeted policy implications based on the influence of socio-economic factors that influence food choices and therefore to encourage healthier dietary patterns across OECD countries.

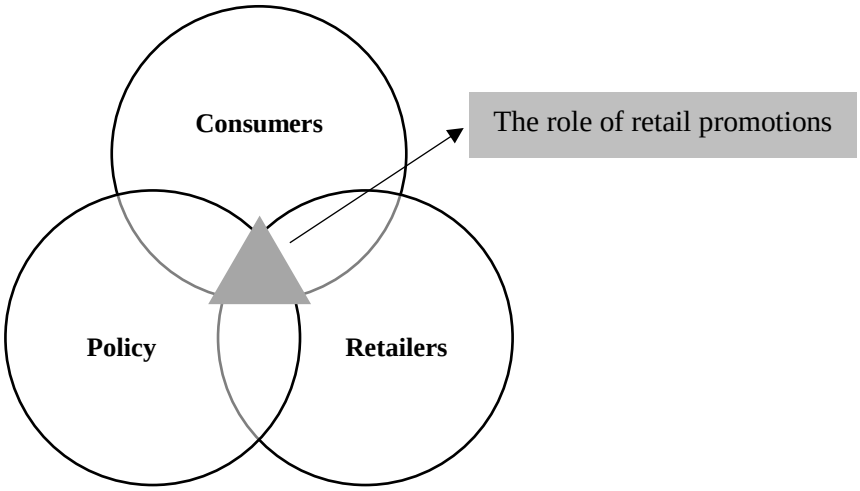
4. To establish policy implications derived from the results across both analyses. Having analysed the results across all chapters, it should give a clear impression of the role of supermarket promotions for

retailers and consumers across unhealthy food consumption and should identify practical strategies to enable healthier food shopping which will help improve consumer diets in the long term.

1.4. Research contribution

In order to address the role of retail promotions, it is vital to highlight the importance of consumers, retailers and governments. Consumers that overconsume food and drinks high in fat, sugar and salt (HFSS) are one of the contributors to weight gain and obesity - imposing a major burden on the NHS and the wider economy. There has been growing concern about the impact of promotional offers on influencing and shaping food preferences toward less healthy products. Retail promotions are a driver of excess purchases and therefore increase consumption which further raises the likelihood of consumers becoming overweight and obese. Governments have tried through voluntary commitments to restrict the use of retail promotions on less healthy food and drink but have been very limited, not implemented consistently and not been successful therefore further legislative intervention is needed to ensure that retails do not encourage purchases and overconsumption of less healthy products. This novel approach to link the three parties of interest on the role of retail promotions – supply, demand and government perspective. This integrated framework reinforces the significance of the current research and the contribution it adds to the existing literature.

Figure 1.1 The role of promotions between retailers, consumers and policy.



This research links the three parties of interest (retailers, consumers and policy) with the key food category of breakfast cereals (Figure 1.1). The most commonly promoted categories of foods are pre-sugared breakfast cereals, soft drinks, savoury snacks, confectionery, and fast foods. The estimated proportion of marketing that promotes these product categories to children varies between 60 and 90 per cent. Moreover, some marketing techniques used are highly engaging and attractive to children (Cairns et al. 2013). The thesis proposes an in-depth investigation of micro-level data in order to improve the theoretical and practical knowledge about retail promotions, which are not only frequently

used by retailers but also criticised by governments across the world. The study aims at advising retailers and consumers how to play a small but significant role when trying to reduce the obesity problem in the UK. Moreover, it seeks to answer the call of several papers in the literature that claim a lack of empirical studies that deal with the differentiation of supermarket types (Hawkes 2009; Nakamura et al. 2015). These studies underline the need for more research across retail promotion types because they clearly have a different impact on retailers and consumers, especially when including the healthiness of the food products under promotion. This thesis makes contributions in the following areas:

(1) As a main novelty, the study investigates retail promotion types and their influence on sales and purchases with scanner data. The study looks at the role of price and volume promotions across retailer, consumer and the policy perspective through the same dataset. Based on the type of analysis examining the retailer's perspective through products sold and the household's perspective through products purchased is a novel contribution to the current literature.

(2) In addition, this study uses the UK FSA nutrient profiling score to assess the healthiness of each product in the dataset. This is especially stressed in Chapter 4 because the health score is not only included as a product characteristic but also the dataset has been analysed separately based on the definition of the UK FSA score on healthy and less healthy. To the best of the author's knowledge, no empirical studies looked at the influence of price and volume promotions and combined it with the degree of healthiness across the crucial breakfast cereal category.

(3) The food economics literature contains gaps because the majority of studies examines price reduction promotions instead of including multi-item promotions such as volume promotions. Moreover, there is the need for research on the effect of supermarket promotions on the consumption of energy-dense, nutrient-poor foods relative to the absence of promotion. This study will address both and include the volume promotion in the analysis but also compare the promotions relative to no promotions applied. This adds knowledge to the literature as several earlier studies only deal with on and off promotion, mainly due to a lack of data studies and were unable to differentiate between promotion types (Kaur et al. 2020).

(4) Furthermore, the review table in the methodology chapter highlights the contribution to the literature from a methodological point through a non-linear fractional multinomial logit analysis on product level data and a quantile regression on household level data to investigate the tails of the distribution.

(5) Moreover, it contributes to the evidence base linking less healthy dietary patterns and food consumption to ultra-processed foods. This study will examine the food category breakfast cereals. This study is highly relevant for the UK context knowing that no previous study has examined the

differences in food purchases made under promotion types across breakfast cereals among Scottish households. Further, this study contributes to the urgent and pressing issue of the role of ultra-processed foods, which includes breakfast cereals. This study intends to clarify whether these purchasing patterns differ by the healthiness of breakfast cereal products, but also across different SES groups. Particularly, the healthiness of each product is assigned with a UK FSA score instead of food category level.

A recent study by Zorbas et al. (2020) mentions that research is needed to further investigate (i) the causal influence of retail promotions on purchase behaviour and the difference across healthy and less healthy products but also across different sub-groups of the population such as certain socio-economic household characteristics, (ii) the influence of different types of retail promotions (such as comparing price promotions to volume promotions) and (iii) how consumers and retailers would respond to policies that would target the reduction of the influence of unhealthy retail promotions. This study will address all three parts of the call.

As part of this thesis, the author conducted a secondment to the Organisation for Economic Co-operation and Development (OECD) and some results of the report will be explained throughout the thesis. The report was published in February 2021 under the title "Socio-economic and demographic aspects of food security and nutrition" of the OECD Food, Agriculture and Fisheries Papers, No. 150 (Placzek 2021). The report fits in with the overall thesis as it investigates also the socio-economic determinants of food choices. It highlights key socio-economic characteristics but also examines less healthy food choices across SES groups. Further, it includes the role of retail promotions and food marketing and the restriction of those, and therefore contributes to the study. Further, the report adds the policy perspective across OECD countries to the thesis, which is needed to include the bigger picture beyond Scotland and breakfast cereals to have an impact on encouraging healthier diets. Nevertheless, obesity levels in Scotland are among the highest of the OECD countries with the energy density of the average diet in Scotland estimated to be 40 per cent over the Scottish dietary goal (Scottish Government 2019). It is further included because it sheds light to both supply and demand side but also informs about recent policy implementations and regulations across a broader context.

1.5. Structure of the thesis

The thesis comprises seven chapters which are structured and grounded on conceptual and theoretical roots, arguments and analytically systematic discourse. These are detailed below:

Chapter One provides a brief overview of the study. It highlights the study's background, the research aims and objectives but also reveals research questions, the research contribution, and last the structure of the thesis.

Chapter Two reviews the literature on the role of food marketing in the supermarkets focussing on retail promotions and further includes the context of the increasing obesity crisis and unhealthy food consumption. This chapter supports the focus of this research and justifies the use of breakfast cereals as a food category and Scotland as a country of analysis.

Chapter Three describes the data used in this thesis and the construction of the dataset. It provides further information how the healthiness of the products is defined through the use of the UK FSA nutrient profiling model.

Chapter Four looks at the influence of retail promotion across products sold from a retailer's perspective. It provides an overview of the concept and reviews the current literature on the prevalence of promotions at product-level.

Chapter Five examines the role of retail promotions from the consumer side using the household-level purchases investigating the socio-economic characteristics and across the healthiness of the purchases made. It reviews previous empirical studies across different household characteristics and identifies the research gap.

Chapter Six examines the power of retail promotions and policies to encourage healthier food choices. This chapter briefly introduces how promotions can encourage unhealthier food purchases from a policy perspective and includes the recent policy developments across the United Kingdom. Moreover, it presents the policy implications based on the finding of the previous chapters including product and household level specific recommendations.

Finally, **Chapter Seven** concludes this thesis. To begin with, this chapter recalls the main findings of this research and then explains these findings. Here the research questions proposed in the thesis are fully addressed. Here, the research aim, objectives and questions are all linked to the findings obtained in this study. Both theoretical and practical implications are presented, the limitations acknowledged and areas for future research identified.

Chapter 2

2. Unhealthy diets, food marketing and retail promotions

This chapter aims to provide a review of the literature on the obesity crisis, unhealthy diets and the influence of marketing on food purchases. In doing so, the role of promotions from the retailer's and consumer's perspective is explained. The second major theme, the food category breakfast cereals, will be discussed and why it was chosen for this thesis. Further, it introduces Scotland as a case study and justifies the reasoning to use it as a setting for the research.

The rest of the chapter is organised as follows. Section 2.1. describes current situation on the obesity crisis, unhealthy diets and the role of ultra-processed foods, Section 2.2. focuses on the influence of food marketing on purchase behaviour and Section 2.3. deals with the supermarket environment in the UK. Section 2.4. elaborates the role of retail promotions in the United Kingdom investigating the manufacturer and retailer perspective but also comparing it to the consumer's perspective and highlights why retail promotions are so vital in influencing consumer purchases. Section 2.5. describes the importance of the breakfast cereal category across the consumption and the variety in products and healthiness but it is also a food category highly marketed and promoted from the manufacturers as well as from the retailers and target both adults and children. Section 2.6. discusses the relevance of the Scottish context as it is struggles with high obesity rates and unhealthy diets. Further, the use of retail promotions linked to policy approaches taken by the Scottish Government are explained. Section 2.7. concludes the chapter highlighting the research gap.

2.1. Obesity, unhealthy diets and the role of ultra-processed foods

In developed countries the overweight and obese proportion of the population has been increasing over the past decades and now in 34 out of 36 OECD countries more than half of the adult population is overweight with 25 per cent obese. Between 2010 and 2016 the absolute number of people with obesity increased by 50 million across OECD countries. Although lower than in adults, childhood obesity is

growing and currently nearly 20 per cent of children in OECD countries are overweight with 10 per cent of obese. Overweight children are 13 per cent less likely to perform well in school and less likely to complete higher levels of education in comparison to children with healthy weights (OECD 2019b). The effects of obesity are costly for individuals and economies reducing educational attainment of overweight children, impinging labour force participation and productivity and perpetuates inequalities. It is estimated that effects on labour market outputs as a result of overweight adults effectively reduces workforce participation by 18 million full-time workers in OECD countries and reduces gross domestic product (GDP) by 3.3 per cent. More taxpayer dollars are allocated towards covering costs associated with overweight with costs per capita approximately 359USD annually (OECD 2019b). Moreover, health is impacted severely due to overweight and obesity. Life expectancy is reduced by 2.7 years in OECD countries as a result of populations being overweight. Common diseases associated with obesity include diabetes type 2, cardiovascular diseases, and cancer and it is predicted that obesity will be responsible for 220 million of non-communicable diseases over the course of the next 30 years. Health care expenditure is predicted to increase by USD 209 per capita across the OECD with countries spending 8.4 per cent of all health expenditure to treat conditions of obesity over the next 30 years (OECD 2019a).

Obesity disproportionately impacts different socio-economic groups especially those from low socio-economic groups. Individuals from low income and education strata are two to three times more likely to be overweight or obese in comparison to those from highest income and education groups (OECD 2019b). Rise in the rates of obesity is an emerging trend along with household food and nutritional insecurity in some developed countries. It is estimated that 8-20 per cent of the population are affected by food insecurity (Pollard and Booth 2019). The co-existence of obesity and food insecurity shows that overconsumption and undernutrition can occur at the same time within one country, but also within one household. Prevalence of obesity in the UK is 26.2 per cent (of total adult population aged 15 years and over in 2016), the 11th highest across all OECD countries. Treating obesity and its consequences costs the NHS £5.1bn every year based on a Public Health England report (Tedstone et al. 2015). Another impact is that British boys were 58 per cent less likely to have completed higher education by the age of 29 if they were obese at the age of 16 (OECD 2019a, 2019b).

Approximately 3 billion people are consuming low-quality diet that either contains insufficient calories, vitamins and minerals or contains too many calories, saturated fat, salt and sugars (Global Panel on Agriculture and Food Systems for Nutrition 2016). One part of the increasing worldwide obesity rate is linked to unhealthy dietary patterns (Turrell et al. 2002; Steenhuis et al. 2011; Appelhans et al. 2012; Ball et al. 2015; Powell et al. 2016). Increasing consumption of sugars, salt, oils and fat via processed foods is associated with higher prevalence of overweight, obesity, and non-communicable diseases (NCDs), contributing to overall levels of malnourishment and the global disease burden. Processed food refers to any food that has been altered from its raw state and therefore food products vary in their degree of processing and nutritional qualities. Part of consumer's food choices are for

example minimally processed food products that have been for instance peeled, washed or frozen, however many processed food products are the result of multiple high-tech industrial procedures, often involving the addition of salt, sugar, oil. The NOVA classification is most common framework used in the scientific literature. It categorises food into four groups based on extent and purpose of processing, from unprocessed and minimally processed foods (e.g., frozen or dried fruits and vegetables) to ultra-processed foods (Monteiro et al. 2018).

Ultra-processed foods (UPFs), the category with the highest degree of processing, is defined as formulations of ingredients that result from a series of industrial processes (hence 'ultra-processed'). Examples include soft drinks, sweet or savoury packaged snacks, frozen meals, confectionary, mass-produced packaged breads, chicken nuggets and other reconstituted meat products, instant noodles and soups, and other ready-to-eat formulations (Monteiro et al. 2018; Rauber et al. 2018) . The consumption of ultra-processed foods (UPFs) has increased world-wide and this food category is characterised by high availability, low cost as well as strong marketing presence. All these factors increase excessive consumption, which due to the poor nutritional quality, impacts health in terms of overweight and obesity as well as hypertension or metabolic syndromes. UPFs have low nutritional quality and high energy density. Studies have investigated the nutritional content of ultra-processed foods and found that when the consumption of ultra-processed food increased, the dietary content of carbohydrates, free sugars, total fat, saturated fat, and sodium increased significantly while the content of protein, fibre, and potassium as well as vitamins and fruits and vegetables decreased (Rauber et al. 2018). A recent New Zealand study finds that price promotions are more applied for processed (59%) and ultra-processed foods and beverages (55%) compared to minimally or unprocessed foods and beverages (45%), which underlines the influence of price promotions towards less healthy foods (Zorbas et al. 2020).

In the United Kingdom, the consumption of ultra-processed foods plays an important role because it accounts for 50.7 per cent of the British food consumption. This is the highest percentage compared to other European countries, for example 10.2 per cent in Portugal, 13.4 per cent in Italy and 46.2 per cent in Germany (Monteiro et al. 2018). Moreover, the study found a significant positive association between the national household availability of UPFs and the national prevalence of obesity among adults. As mentioned above, the United Kingdom has a high prevalence of overweight and obesity accounting for 63 per cent of the population in 2018 (Monteiro et al. 2018; Rauber et al. 2018). The food category breakfast cereals is also classified as ultra-processed food and will be analysed in this study. Ultra-processed foods include sweetened breakfast cereals and ready-to-eat cereals, whereas plain oats, plain corn flakes and shredded wheat are minimally processed foods. While the same foods are processed, the change to ultra-processed happens when they contain artificial flavours or colours (Monteiro et al. 2018). Overall, the extensive accessibility of ultra-processed products has been identified as one of the main food system drivers of malnutrition (Swinburn et al. 2019; Machín et al. 2020).

2.2. The influence of food marketing on consumer purchase behaviour

The food environment signals consumers what to purchase and includes for instance availability, affordability, convenience, and desirability of various foods. Another important variable is income, and the earlier literature largely agrees that the effect of income on dietary consumption is always modified by the food environment (Herforth and Ahmed 2015). A great influence on consumer's food purchases is food marketing. Foods are often sold and accompanied by aggressive marketing strategies, which try to shape consumer preferences and impact overall dietary patterns (Cairns et al. 2013; Monteiro et al. 2018). These marketing strategies used by the food industry can be divided into different areas. It consists of brand building, which addresses the consumer's perception of the brand and company. Other marketing approaches and techniques include the outreach to the consumer through advertisement in TV and digital advertising for instance through social media. Another part of marketing is done in the retail and food environment. These tools include for example vouchers, loyalty cards but also in-store displays linked to for example a promotion. This study focuses on in-store promotions, which are often classified as a price reduction or a multi-buy offer. The price of a good is a critical influence on food purchase decisions made by consumers in the retail environment, underlining the fact that retail promotions are a crucial factor influencing food choices (Backholer et al. 2019).

As a matter of fact, marketing strategies are likely to target children for several reasons. Children are vulnerable to the influence of food marketing, which affects their eating behaviour and children in England are exposed to a high volume of marketing and advertising in many different forms. The evidence demonstrates that on the one hand TV is the dominant marketing technique influencing food preferences. But on the other hand, marketing tools such as advertising, use of characters and spokespeople, branding, product size, supermarket product placement and discounting all influence preference for high sugar product selection (Tedstone et al. 2015). Food promotions have a direct effect on children's nutrition knowledge, preferences as well as their purchase behaviour and consumption patterns and diet-related health. Children will be a consumer in the future and persuasive food marketing early in their life might guarantee a loyal consumer for a lifetime (Folkvord et al. 2016). Moreover, children are often the target of marketing strategies not only as a consumer on their own but also as intermediate between the parents and the peers who can influence other consumers. Most common promoted categories of foods to children are pre-sugared breakfast cereals, soft drinks, savoury snacks, confectionery and fast foods (the estimated proportion of marketing promoting these product categories to children varied from 60 to 90 per cent) (Cairns et al. 2013). Evidence shows that certain socio-economic groups are more susceptible to junk food marketing because of lower levels of higher education and are less critical thinking (Hemmingsson 2018). Therefore, this study will include various socio-economic characteristics of households such as the household composition (e.g., with or without children) to analyse the role of supermarket promotions across different SES groups.

However, it is necessary to acknowledge that most food choices are based on intuitive thinking, which results in effortless and fast decisions that are not conscious and are often led by habits. Health, price, convenience, mood, ethical concerns, natural content, and weight control all influence food choices. One of the most important factors influencing food choice, food preference and dietary habits is sensory appeal. This includes taste, smell, sight and texture of food. Food choices during adulthood are mainly shaped by food preferences and food experiences encountered when growing up and is therefore often linked to the familiarity to certain foods (Placzek 2021). This underlines the key role of the socio-economic background of consumers and the impact of foods consumed during childhood on future food choices. Food consumption is not based on purely rational behaviour. Healthy food choices can compete with food preferences, creating demand for unhealthy food options because of attributes such as taste and convenience. Health is an invisible product characteristic and there is no immediately visible effect of unhealthy eating. That said, consumers are able to change their food consumption behaviour quickly when there is a perceived food safety risk leading to a direct effect on health such as the fear of salmonella (Aschemann-Witzel et al. 2018).

Considering the health aspect of food, less healthy foods are advertised more in terms of frequency compared to foods and beverages that are components of a healthy diet. A meta-study finds a positive association between food promotion and the consumption of food with an increase in snacking, higher energy intake and less healthy food choices (Cairns et al. 2013). Foods that are high in fat, salt and sugar are primarily promoted. Among these foods, savoury snacks and confectionary were the most heavily marketed and also the most consumed (Matthews 2008). Spending on junk food (less healthy foods) advertising is nearly 30 times higher compared to government spending on promoting healthy eating in the United Kingdom (O'Dowd 2017). Annual reports from leading convenience food and beverage companies show high expenditures for advertising and marketing activities. In 2014 the UK food industry spent £256 million promoting ‘unhealthy’ foods sold in retail alone (Tedstone et al. 2015).

2.3. Retail environment in the United Kingdom

Food marketing is closely linked to the grocery retail market, which was valued at £184.8 billion in 2018 across the UK and has the power, influence and expertise to support healthier eating and to positively influence the diets and health of the population (ATNI 2020). The supermarket environment in the United Kingdom is unique due to the fact that the 10 largest retailers account for 94 per cent of the grocery market share, their reach has substantial influence over the consumers food choices and food access. Families in the UK spend about 80 per cent of their budget for food that is eaten at home in supermarkets and therefore offering a great opportunity to transform diets and eating habits (ATNI 2020). The influence of the consumers food choices and purchases is expressed through for example,

packaging, labelling, but also formulation and pricing, promotion and advertising of their own-brand and branded products.

When investigating supermarket promotions, the type of supermarket, their pricing and promotional strategy plays an important role especially because this research focuses on the United Kingdom. According to Ejlerskov et al. (2018b), due to the dominance of a few supermarkets in the UK, nine large national supermarket chains dominate 90 per cent of the UK food retail market share: Aldi, Asda, Coop, Lidl, M&S, Morrisons, Sainsbury's, Tesco, and Waitrose. The UK food sector has become more concentrated in the past years, which is now one of the most concentrated and are differentiated retail market in the European Union (EU) and can be characterised as a tight oligopoly (Lan and Dobson 2017). The "Big 4" retailers are Tesco, Sainsburys, Asda and Morrisons and are mainly large-format superstores. Smaller chains with special appeal are for example Marks and Spencer's and Waitrose focussing on high income consumers. Convenience formats are for example Co-operative Food with a strategy towards neighbourhood retailing. Discount retailers are shops such as Aldi and Lidl offering largely private label products on a limited product range sold for cheap prices (Lan and Dobson 2017). Discounters apply a different strategy than for instance supermarkets including the reduced use of price promotions as they try to target low socio-economic status consumers with constantly lower food prices. Pechey and Monsivais (2015) categorise M&S, Ocado and Waitrose as high-cost supermarkets, Asda, The Cooperative, Morrisons, Sainsbury's, Somerfield and Tesco as medium and Aldi, Farmfoods, Iceland and Lidl as low-cost. A different classification is proposed by Lan and Dobson (2017) who describe the UK retailers as the following: Sainsbury's as more upmarket, Asda more price focused as an 'every day low price' (EDLP) positioned retailer. Morrisons is seen as value-oriented and Tesco has taken the middle ground as the retailer and is the market leader.

The importance of retail types is underlined by the retailing growth across the retail environment. According to ATNI (2020) the market share of grocers in Great Britain in 2019 was Tesco (27%) and Sainsbury's (15.4%) who had the largest shares followed by Asda (14.9%). Prior the growing popularity of the discounters, the UK market was dominated by the big four Tesco, Sainsbury's, Asda and Morrisons. Morrisons (10.1%) is followed by Aldi (8.1%), The Cooperative (6.6%) and Lidl (5.9%) and Waitrose (4.9%). Similar data supports these shares coming from the Living Costs and Food Survey which is fully representative of UK household food shopping. Consumers have shifted more to cheaper alternatives such as discount chains such as Aldi and Lidl. However, these different chains have different store formats such as supermarkets or convenience stores, which for example are important formats for Tesco as they had more convenience stores than supermarkets in 2013. The rise in importance of the UK convenience market had major implications in the British retail environment and these stores can be located in very different types of space – rural villages, city centre train stations, suburban town centres, etc. By 2012, the symbol groups had 40 per cent of the market share within the UK convenience market, with sales of around £13.6 billion, having increased from 22 per cent in 2000 and predicted to increase to 50 per cent by 2020 (Hood et al. 2016).

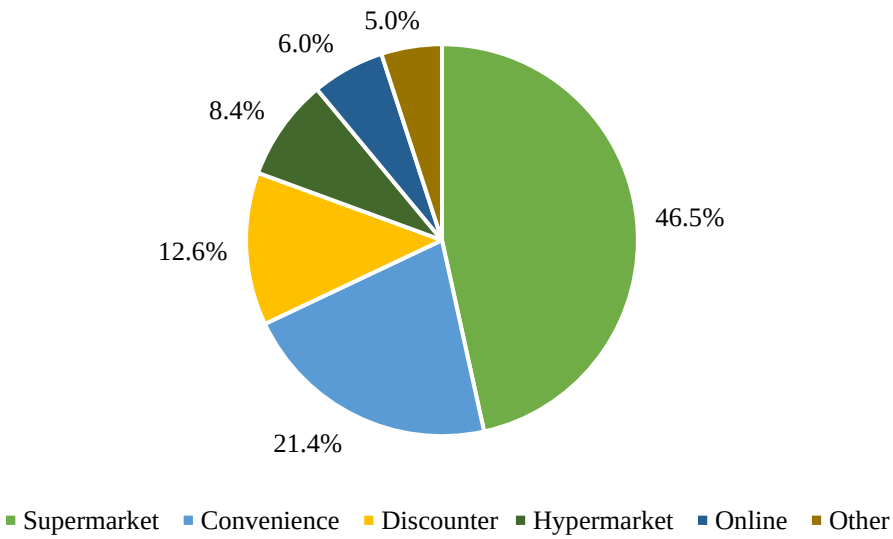
The environment is often categorised into two separate levels – macro-level covering the proximity and density of food outlets and micro-level dealing with the food availability and accessibility within food outlets and both impact the consumption of less healthy foods in a different way. For instance, in the micro-level environment it has been found that healthy food products were cheaper in larger stores (e.g., supermarkets) compared to smaller ones (e.g., convenience stores), where less healthy foods have also been more common (Howard Wilsher et al. 2016).

Broadly speaking, different formats across the UK retail environment include:

- **Hypermarkets:** Large format stores that sell a full range of grocery items and a substantial non-food range. Sales areas are typically 60,000 square feet.
- **Supermarkets:** Defined as food-focused stores with sales areas of between 3,000 and 60,000 square feet
- **Convenience stores:** Stores with a sales area of less than 3,000 square feet, which are open for long hours and sell products from at least seven grocery categories.
- **Discounters:** Includes all sales through food discounters Aldi, Lidl and Netto and the grocery sales of the high street discounters such as Poundland and B&M.
- **Online:** Internet orders placed at grocers and online food specialists for home delivery and customer collection
- **Other retailers:** Includes stores with a sales area of less than 3,000 square feet, typically newsagents, off-licences, some forecourts and food specialists, such as butchers and bakeries. This channel also includes the grocery sales of predominantly non-food retailers such as department stores

Figure 2.1 shows the various retail channels in total UK market and their shares across the various formats. Supermarkets have the greatest share with 46.5 per cent followed by the convenience format of 21.4 per cent and then the rise of retailers over the recent years is seen through a share of 12.6 per cent.

Figure 2.1 Retail channel share of total UK market.



Source: Retail Analysis from IGD (2019)

Consumer Buying Behaviour

The field of consumer behaviour studies how individuals select, buy and use goods and services to satisfy their needs and desires, which includes consumer food choices (Kotler 2000). This underlines that consumer behaviour is linked across all aspects of purchase decision, usage and disposal of the product, including decisions made regarding purchase and the purchase patterns of a consumer. Through implementing promotion techniques for example in supermarkets, marketers want to influence the purchase decision of the consumer and motivate them to invest in for instance a certain product. The influence of purchasing behaviour of consumers through price promotions has been investigated in the literature and it has been found that price promotions persuade consumers to switch brands, but also experiment with unfamiliar products and stockpile instead of purchasing products when needed (Smithson et al. 2015). Further, this might result in e.g., impulse buying, stockpiling, brand switching, purchase acceleration when retail promotions are implemented successfully. Consumer behaviour theory explains the decision-making models behind the consumer choices for instance through the Consumer Decision Model also known as the Engel-Blackwell-Miniard Model originally developed in 1968 by Engel, Kollat, and Blackwell. This model underlines the decision making process stages which are affected for instance through individual characteristics (e.g. values), social influences (e.g. cultures) and situational influences (Engel et al. 1968).

The complexity of consumer choices is vast but needs to be highlighted in order to be able to understand consumer behaviour especially applied to food consumption decisions. Also, the Theory of Buyer Behaviour developed by Howard and Sheth in 1969 is important and can be linked to behaviour

types such as Dissonance Reducing Buying Behaviour, Complex Buying Behaviour, Variety Seeking Buying Behaviour and Habitual Buying Behaviour (Bray 2008).

Machín et al. (2020) highlight in their study that food purchases tend to be highly repetitive and habitual as consumers tend to buy the same products often from the same brands even linked to the same supermarket with repeated visits. Habitual purchases are often linked to the choice of food products within a specific food category with a number of alternatives in retailers. Consumers are then expected to minimise their cognitive burden and information acquisition and do not engage in a detailed information search while being in the supermarket. Overall, this section underlines that consumer behaviour and food purchases are highly complex with several external and internal influences on perception, attitude and action, but it also includes food-related decisions such as product attributes, characteristics of the consumer and the eating environment that all play key roles (Bray 2008).

Promotional strategies have an impact on the supply side (retailers), the demand side (consumers) as well as other competitive factors. There is a large body of studies on supermarket food prices and pricing behaviour, as well as consumption behaviour. This study integrates several areas of interest: marketing, nutrition, psychology, public health, and behavioural economics and consumer behaviour. A combination of research areas has been reviewed due to its complex and multi-dimensional nature to investigate the gap and contribute to the evidence base. The Fast-Moving Consumer Goods (FMCG) industry includes all products that are purchased mainly in supermarkets, which are household items that tend to be high in volume and low in costs but also are quick to leave the shelves. These products are often advertised in various ways such as through television advertisement or through supermarket promotions. General factors that affect promotion in the FMCG industry are for example characteristics of the product itself, the product category, the retail type, the promotion types and the consumer characteristics can influence the effect of sales. The review of Hawkes (2009) finds the following: The extent of the effect of sales promotions varies across the degree of perishability or storability of the food, but also across the degree of convenience and desirability. Consumers are more likely to buy food products under promotion if they are storable thinking to save money when purchasing the product now and then storing it for later. However, it has been found that the stored food will be consumed faster (Chandon and Wansink 2002). Supermarket promotions are extremely effective in changing consumer behaviour uplifting sales and is especially evident for lower socio-economic status consumers, but also female consumers aged 30-40 years old and those who go shopping without a shopping list (Safefood 2019).

2.4. Retail promotions in the United Kingdom

Supermarket promotions on food products are more widespread in the United Kingdom compared to other countries in Europe. Foods on promotion account for around 40 per cent of all expenditure on food and drinks consumed at home and evidence shows that higher sugar products are promoted more

than other foods. Retail promotions accounted for almost 66 per cent of the marketing budget of consumer-packaged goods in 2016 by far exceeding advertising expenditures (Lu 2017). A report by Public Health England underlines that promotions increase the amount of food purchased by one-fifth and these are purchases consumers would not have done without the supermarket promotion. The direct link between promotions and increased sugar consumption has been made: Almost 9 per cent of the sugar brought into the home is a direct result of the extra food and drink purchased on promotion (Smithson et al. 2015).

There are various types of supermarket promotions all including a variety of special offers available in the retail environment which are characterised by offering a discount on the usual selling price and are typically restricted to a specific range, product or pack format. Supermarket promotions are a better price-value ratio of the products for the consumers and this is achieved through using for example a temporary price reduction or increased volume for the same price (Ravensbergen et al. 2015). Promotion is all about the perceived value of the promotion and the presentation of the deal is a major determinant of the promotion's effectiveness (Drechsler et al. 2017).

The three most common promotion types in the United Kingdom are:

- **Temporary Price Reduction** (e.g., '25% off'): A short term reductions to the price of food and drink products for a few weeks and after the price returns to regular.
- **Multi-buy** (e.g., BOGOF/x for £y): A multiple unit promotion where shoppers are required to buy one or more items to benefit from the discounted price.
- **Extra Free** (e.g., '25% free'): A promotion where the size of a food or drink product is temporarily increased, and this is highlighted on pack.

A study of Bogomolova et al. (2015) looks at promotion types and depth comparing promotions in the FMCG industry in the UK and the US and finds that the most frequent tool across the years 2005-2012 is the price promotion (13%), which accounts for half of the sales, the x for £Y (8%), the multi-buy (7%) and the least common being the extra free tool (2%). Often in the literature price promotion includes both price-based (50% off) and volume-based promotions (BOGOF). This study differentiates between the two types and therefore as a general term "retail promotions" is used and when a differentiation is made then "price promotion" and "volume promotion" will be applied to describe temporary price reductions and multi-buys respectively.

Price promotion (or price reduction or single-item promotion)

One type of a retail promotion is the temporary price reductions (TPR). Through a monetary reduction in the regular price the consumers can purchase a product cheaper than they normally could e.g. 15 per cent off the regular price. In the FMCG industry, price promotions usually use around half of the

marketing budget. These price promotions consist of two parts – the type of price promotions used, meaning how to communicate the supermarket promotion and the second parts deals with the depth and intensity of the discount. Price promotions are also called single-item promotion meaning that just one product has to be purchased to receive a price discount. Investigating the different supermarket promotions in the United Kingdom, Gilbert and Jackaria (2002) reports that price discount has a statistically significant and strongest influence on purchase behaviour from the consumer's point of view.

Volume promotion (or multi-item promotion)

Another promotion type is a multi-item promotion but also described in the literature as promotional bundling, meaning that two or more products have to be bought in order to receive a price discount (Ravensbergen et al. 2015). Volume promotions have gained popularity, offering consumers a discount providing that a certain quantity of the promoted product is purchased. They can be framed differently such as buy-one-get-one-free (BOGOF) or x for £y, but all include a quantity requirement. The difference is framing the deal through semantic cues because the volume promotions do not offer a discount or a reduced price but appeal with additional units appearing as a free gift (Drechsler et al. 2017). The literature on single unit promotion such as temporary price reductions show the importance of phrasing and presenting the deal and is linked to the effectiveness of promotions. From a manufacturer and retailer perspective volume promotions deliver a stronger impact on volume sales compared to single-unit promotions (Drechsler et al. 2017). Drechsler investigates multi-unit price promotions (MUPs) and finds the superiority of the "X for $Y" above "X + N free" because consumers evaluate promotional frames different based on their semantic cues (Drechsler 2016). Buy-one-get-one-free is the most popular promotion type in the UK and are most likely to influence the sales of non-perishable products (Gilbert and Jackaria 2002; Hawkes 2009). However, the relationship between the quantity requirement of the multi-unit promotions and the purchase quantity per consumer has been found to have the form of an inverted U, which represents that the impact of the promotion decreases after a critical quantity requirement level (Drechsler et al. 2017). Food products are more likely to be purchased under a supermarket promotion if usually consumed frequently. Product that are consumed at a faster pace such as dairy products are more likely to be sold in greater quantities through e.g. buy-one-get-one-free promotions (Hawkes 2009).

Depth and intensity of retail promotions

Dealing with promotions does not only mean various promotion types but also includes promotional intensity, which can be divided into promotional frequency and promotional depth. According to Nijs et al. (2001), promotional frequency is the extent to which consumers are exposed to price promotions as a frequency for example the amount of price promotions within a week. However, the promotional depth is the size of the promotions, which is the reduction in price in pounds. Promotion intensity (in

this study) can be defined as the depth of a discount on a product given by a promotion type. This study investigates the influence of different promotion types and the interaction of the promotion depth. In the UK, the average discount across all promotional purchases was 21 per cent between the years 2005-2012 (Bogomolova et al. 2017). Nakamura et al. (2015) also finds that the unhealthy foods were more likely to have larger proportional discounts. Lu (2017) provides insights into how frequency and depth of promotions affect consumer purchases and seller revenues in the long run and found that deeper promotions perform better than longer promotions and that shorter and deeper promotions generate more revenue than longer, shallower promotions.

Differences and perception across price and volume promotion types

The retail environment with the high prevalence of promotions has raised concerns among consumer advocates and government regulators dealing with potential consumer confusion because different promotion types such as price-off deals, multi-buy deals, freebies, package, and rebates are all framed differently (Tan and Bogomolova 2016). The difference between an equal promotional discount however phrased differently has been examined in the literature - for example, a 50 per cent price reduction and a BOGOF. Prior research has shown that promotion types are perceived differently even though the economic benefit might be the same and therefore the promotional value and store preference are influenced by the perception of the consumer towards the preferred promotion type. The semantic cues and wording play a crucial role in the role of retail promotions among consumers (Smith and Sinha 2000; Hardesty and Bearden 2003). A large body of literature has examined different supermarket promotion types and the perception among consumers. Particularly, multiple authors argue that the monetary value that consumers can save with a promotion is not the main motive to buy a product under promotion (Smith and Sinha 2000; Hardesty and Bearden 2003; Teng 2009). A simple price discounts works by enhancing the customers' perception of savings and value but is not just about the amount of monetary price reduction but also how the offer is shaped and how the promotion is framed. The difference is framing the deal through semantic cues because the volume promotions do not offer a discount or a reduced price but appeal with additional units appearing as a free gift (Drechsler et al. 2017).

A price promotion, a temporary reduced price, results as a benefit for the consumer in a monetary reduction and saving of the total expenditure. It also allows the consumers to decide how to allocate their savings instead of being forced to buy more products than anticipated which is the case with a volume promotion (Smith and Sinha 2000). A temporary price reduction is often preferred and "percentage off" deals are perceived better compared to "pound off" deals even when both types of promotions offer the same amount of savings. The literature has found that a significant number of consumers are confused about the rules of multi-buy promotions and therefore multi-buy deals are perceived as not effective as for example temporary price promotions because consumers feel misled and confused. To illustrate, consumers perceive a BOGOF as less valuable than a "50% off" deal even

though both imply the same amount of savings (Manning and Sprott 2007; Drechsler et al. 2017). A study by Hardesty and Bearden (2003) looks into the promotional benefit level related to two promotion types (price discounts and bonus packs). They find that the effect of price reduction and multi-buys are valued by consumers in a similar way for low and moderate promotional discount benefits, however when the promotional benefit is considered as high, then price discounts are preferred to multi-buys. These different ways of expressing various semantics affect the consumers especially when dealing with lower-priced products and evidence concludes that consumers prefer volume promotion tools even though the costs were the same, however feel more secure and less confused with price promotions.

Overall, promotions such as a volume promotion (for instance a multi-buy) are perceived differently to price discounts even though the monetary saving might be the same. For volume promotions, the increased quantity influences the consumer's decision when making the purchase decision because they need to consider the possibilities to transport and store (Foubert and Gijsbrechts 2010). Another reason is that consumers view promotions framed as a gain more positively than a reduction or a loss (comparing "get one free" compared to "50 percent off") (Smith and Sinha 2000). Based on the prospect theory by Kahneman and Tversky (1979), the different ways of price framing are perceived as positive (gains) or negative (losses) deviations from a reference point which is the reference price or the quantity of the product. This offers an explanation for different consumer reactions to different price frames even if the discounted promotion offers the same saving. As an example, a retail promotion can be formulated in a monetary frame, such as "X for £Y", and it would be a reduction in "the loss", highlighting the reduction of the purchase price. Another way to phrase a retail promotion is in a nonmonetary frame, such as "X + N free", and would be viewed as a "gain" due to the increase of the quantity obtained. Prospect theory says that changes in the loss component compared to changes in the gain component have a larger impact, especially when gain and loss are of the same size. Furthermore, bundling or package promotions are more receptive when promotions offer one large saving on packages instead of two smaller savings even with the same price reduction (Smith and Sinha 2000; Drechsler et al. 2017). A recent study by Hecker et al 2019 supports the theory as they find through the use of tracing eye movements that participants prefer a "buy-one-get-one free" promotion compared to an equivalent price reduction with the same net value. However, previous research has shown that for larger discounts, consumers prefer price reductions to package enlargement meaning that for a promotion without a quantity requirement, higher price discounts are preferred to larger bonus packs due to the fact that consumers find it easier to comprehend and process the higher price discount (Hardesty and Bearden 2003; Gordon-Hecker et al. 2020).

2.4.1. Perspective of manufacturers and retailers

In the United Kingdom, the role of promotions is crucial for this study as evidence has shown that foods on promotion account for around 40 per cent of all expenditure on food and drinks consumed at home.

The use of these retail promotions from a manufacturer and retailer perspective is explained in the following section.

Retailers as well as manufacturers use big data to understand their consumers and their purchase behaviour better, especially when retail data, household information and location-based details are merged together and are analysed further. Part of this thesis is the analysis of the use of retail promotions and their influence on products sold under different promotion types. Promotions used in supermarkets vary between price promotions, displays, promotional flyers, multi-buys, or bonus packs to target consumers. The importance of these promotional tools is underlined by the fact that manufacturer's marketing budget often allocates more than half on it on price promotion expenditure (Bogomolova et al. 2017). However, it is important to differentiate between manufacturers and retailers when investigating supermarket promotions because both apply different measurements and goals.

Price promotions such as temporary price reductions and discounts are used by manufacturers to build brand awareness, to maintain brand familiarity, but also to increase the perceived value of a purchase. This is due to the fact that promotions offer consumers secure brand trial and repeat purchases, thus generating publicity and facilitating the introduction of new products. Also, promotions affect intangible assets such as brand equity and brand loyalty from a manufacturer's perspective. Furthermore, promotions secure retail shelf space and increase sales and market share long term (Simpson 2006). Manufacturers aim to maximise profits for their brands and company, whereas retailers aim to maximise profits of the store, the category and the private labels. Therefore, they use different measures to judge the success of supermarket promotions. Manufacturers use market share, margin, return on investment, and brand equity while retailers focus on store traffic, sales per square foot, store share and profits, and shopper satisfaction (Bogomolova et al. 2017).

The retailer benefits from the use of promotions in-store through increased purchasing and short-term sales, moving large volumes of stock and inventory, and to increase profits. Moreover, they can trigger unplanned and un-promoted purchases among the consumers and also encourage stockpiling which drives retailers' costs of inventory down. Also, supermarkets use price promotions for strategic advantage to win retail market share (Simpson 2006). Another motive is to encourage customers to do more food shopping at the store for other regular priced items, but also to increase sales and therefore profit in specific categories or use them as a form of competition from other competitors (Powell et al. 2016). The retailer's performance is measured with various key indicators. These key measures are divided into different levels such as brand, category, store and customers, and include growth rate of penetration, sales and gross and net profits. For retailers, the measures of most interest are the category and store level, compared to the manufacturers the most important is the brand performance. Individual brand performance is mainly of interest for the supermarkets because brands allow for a different range of margins compared to other brands e.g., private labels versus branded products. The greater the variety of brands the higher the chance of a more successful drive of store performance but also influences attraction of high value customers (Ailawadi et al. 2009).

The tools used to achieve these long-term goals need to be differentiated by manufacturer and retailer. Manufacturer mainly use brand advertising but also trade and consumer promotions whereas retailers utilise store and private label advertising, store coupons and loyalty cards. Trade promotions are an important marketing tool in the retail industry and are promotion agreements between manufacturer and retailers but is also an incentive offered from manufacturers to retailers. Trade promotions are defined as the marketing activity to increase sales of specific products between the manufacturer and the retailer. An example of a trade promotion is the off-invoice policy, which gives the retailer a discount on the ordered quantity by the manufacturer, and therefore the retailer can provide a price discount on the retail price to the consumers in the store. The aim of trade promotions is to offer the end consumer a discount, which are over 60 per cent of the manufacturers budget spend in marketing on packaged products (Ailawadi et al. 2009).

Retail promotions are part of the retailer's strategy to achieve the above-mentioned aims and key performance targets. The retailer decides on price promotions, which include aspects such as the promotion depth, frequency and timing as well as online versus offline promotional strategies. In the retail sector, the manufacturer's promotional strategies can be divided into "push" and "pull". "Pull" is set up around advertising and consumer promotions and can influence the retailer on the regular price or price discounts for the brand. However, the "push" strategy is applied to trade promotions and sales force and impacts for example the wholesale price (Ailawadi et al. 2009). A promotional tool between the retailer and the end consumer are consumer promotions, which retailers use as promotional strategies such as price reductions or deep discount offers to attract consumers. These promotions are useful from a retailer perspective because they not only lead to higher sales for the promoted product but also increases the store traffic so more consumers are likely to purchase additional products in the supermarket besides the promoted one (Ailawadi et al. 2009). A comparison between promotion types is that for example price promotions are used so that the consumers on the one hand switch to a different item or on the other hand to buy more in the category, which is called the acceleration effect. A different promotion type such as a volume promotion tends to be more effective than price promotions when increasing the sales of the item or the brand – especially when the consumer already knows the offered brand and product and takes advantage of the extra volume (Foubert and Gijsbrechts 2010).

Moreover, promotions are used to build relationships between manufacturers and retailers, to allow retailers and manufacturers to stay competitive, to win new customers (for the manufacturers brand but also for the retailer's new store customers), and to maintain loyalty in terms of brand and also store loyalty. With the use of retail promotions, short term sales increases as a measure of performance for both manufacturers and retailers (Smith and Sinha 2000; Laroche et al. 2003; Bogomolova et al. 2017). However, on the other hand, the use of price promotions brings negative long-term consequences for example higher consumer price sensitivity, decreasing brand loyalty, as well as a decreased base price elasticity. Moreover, these promotions are often unprofitable: More than 60 per cent of supermarket promotions in the UK are not making any profit and it is often referred to as the inefficiency

of price promotions, which are partly because of the power imbalance between manufactures and retailers (Bogomolova et al. 2017). Furthermore, among all retail promotions half of the promotions lead to substitution effects between items/brands within a category, without increasing the revenues of the categories and therefore do not increase profits for retailers and/or manufacturers in the long run (Leeflang and Parreno-Selva 2012).

2.4.2. Perspective of consumers

A more consumer-related perspective on retail promotions shows the benefits for the end consumers. Price promotions influence consumer demand. From a consumers' point of view, paying a discounted price allows the consumers to make a monetary saving and enhance the perception of value. Promotion tools also make the shopping experience more interesting and provide an incentive to discover and experiment with new products (Smith and Sinha 2000; Laroche et al. 2003). However, negative consequences of the frequent retailer price reductions on the consumers are that price reductions lower the perception of value as well as impact negatively on the brand preferences (Hardesty and Bearden 2003). Retail promotions often lead to different behaviours among consumers - purchase acceleration (regular consumption but stockpiles products for later); increasing quantity (increased consumption due to the promotion) and switching behaviour (switching including substitution through category switching, brand switching and store switching) (McColl et al. 2020).

This study will investigate the socio-economic characteristics of the consumers who are more likely to purchase products under different promotion types in supermarkets. A body of literature states that price-conscious consumers are also the most deal-prone. The evidence on sociodemographic characteristics of consumers that are associated with "deal proneness" has been inconsistent according to Hawkes (2009) and it appears that price-consciousness, psychographic and purchasing-habit variables (such as impulsiveness and innovativeness of the shopper) are more important when defining deal-prone consumers instead of certain sociodemographic characteristics. Arce-Urriza et al. (2016) argue that promotions have a higher impact on offline purchases compared to online purchases, even no significant effect of promotions has been found using the online channel. A possible explanation is that consumers purchase foods online mainly to save time and for convenience reasons, and when shopping in-store customers take more time to look around and search for promotions.

Another important effect is the stock-up effect, which includes the characteristic of a purchased product such as being perishable and able to be stocked. It includes buying more of the product because a promotion is applied however it depends on factors such as frequency to use, impact of total costs and the cash flow as well as the possibility to store the products. The perception of a promotional deal is therefore influenced by the product characteristics. For example, a product of a non-perishable food category such as breakfast cereals will be perceived more positively towards a volume promotion compared to a product that is easily perishable (Smith and Sinha 2000). However, the issue of

stockpiling is the increased consumption (often an immediate overconsumption) instead of purchasing products at a cheaper price and consuming it later when needed (Chandon and Wansink 2002).

Still the evidence is not consistent whether price promotions attract shoppers within a supermarket to purchase a brand that they usually would not buy and then repurchase the same brand later. Analysing 18 consumer good categories in the UK and the USA using Kantar and IRI data, Dawes (2018) finds that promotions increase unit sales, but most of the promotions bought by consumers are brands that have already been bought at least once as part of the past five category purchases. The author documents the lack of aftereffects for price promotions in terms of long-term as it is unlikely that consumers who have never or rarely purchased a brand will do it due to a promotion. A price cut is therefore attractive for a brand that is familiar for a consumer but less likely to be effective for a new brand (Dawes 2018).

However, since 2015 the consumer's perspective towards retail promotions has changed; a decline of purchases made under promotion was found, as consumers have changed their perception and developed to prefer 'everyday low prices', which is clearly linked to changes in market trends and the rise of discount retailers. This finding is supported by Smithson as the decline has largely been driven by shoppers' purchasing more in discounters, but also other retailers adopting more low-price strategies. This low-price strategy replaces the extensive use of promotions and therefore is not reflected in the data as promotional purchase (Smithson et al. 2015; Campbell et al. 2020).

2.4.3. Economic theory: Consumers' response to price promotions

Economists have developed economic models to explain how individuals engage in different consumption behaviours, and some key models include price elasticity of demand; potential substitution effects; impact on health inequalities; passing on of a tax or subsidy to the consumer, which are all mentioned throughout this thesis. According to standard economic theory of rational demand which applies for most consumer goods, an inverse relationship between the change of the price of the product and consumer's response to the demand, indicating that when the price of a good increases, the demand goes down, and vice versa. This means that retail promotions are likely to have a positive effect on demand and can therefore lead to an increase in sales. Interestingly, theories exist that differentiate the impulsive demand for healthy and less healthy products, which refers to an over-consumption impulse for unhealthy foods and an under-consumption impulse for healthy foods (Backholer et al. 2019).

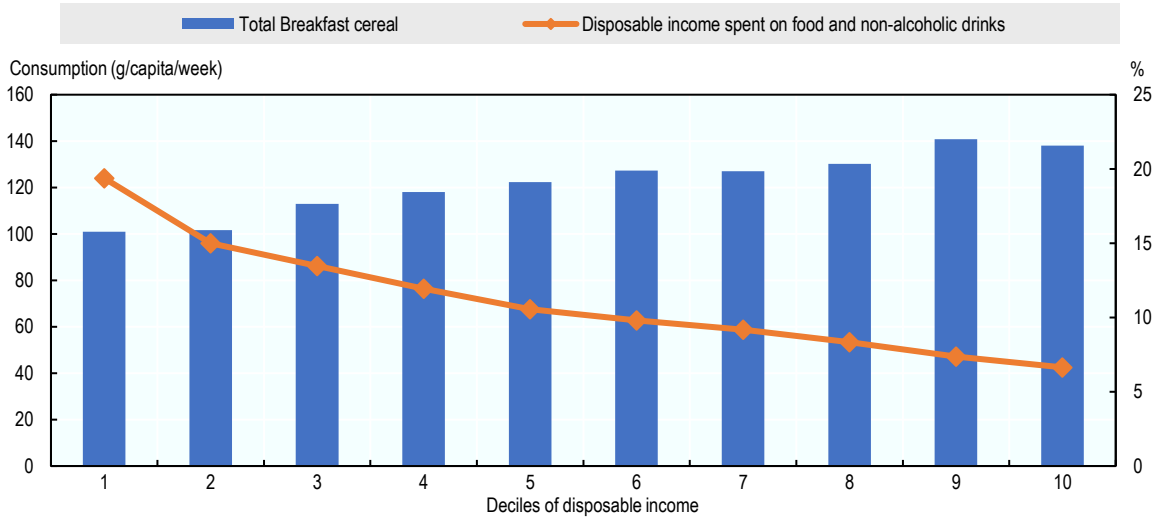
Another approach to economic theory is that many agricultural interventions aim to improve incomes, but also increase the food availability and a reduction of food prices. The question is whether the food environment supports and encourages the use of income on healthy diets. Standard economic tools exist to describe the relationship between income and food consumption, as well as dealing with changes in income and changes in consumption such as Engel curves and income elasticities (Herforth and Ahmed 2015; Clements and Si 2018). Price promotions are not explicitly addressed in neoclassical

economics; however, their impact on consumer behaviour can be inferred using demand theory, because retail promotions imply a change in prices. The consumer chooses the best option for him/her in order maximise utility subject to income, time and other resource constraints. In the food consumption context utility is maximised for the consumer simply through buying more of a good at a lower price. Consumer's total utility is maximised when selecting a combination of goods, however the model assumes fixed prices, but price promotions in supermarkets implicate lowering the price of a good. The decrease in the price of a product is equivalent to an increase in real income, because with the same amount of money, more can be bought and this leads to an increase in purchasing power (Tomek and Kaiser 2014). Besides, the price promotions target especially the low-income consumers that use promotions to economise better with their disposable income in the short-term compared to a volume promotion that simply offers more quantity of a product (Powell et al. 2016).

Another important concept is the price elasticity, which plays an important role when dealing with price promotions. By definition, it measures how a change in price can affect the demand – a percentage change in quantity demanded in response to a percentage change in price (Tomek and Kaiser 2014). When looking at the influence of retailer promotions on the food demand from a consumer's perspective, it has to be established that food products are in general price and income inelastic and that both price and income have a key relationship due to the fact that price elasticity declines with income, however price and income elasticities for food tend to be low. Food demand is relatively inelastic, but the power of changes in price changes consumer purchase behaviour across an entire population, especially among low-income groups. Targeted food pricing policies through for example price changes could alter the diets and nutritional health of these groups more than those of high-income as lower income consumers are more price sensitive and therefore promotional offers may be a potentially effective way at changing dietary choices (Ni Mhurchu et al. 2013).

A related concept to income elasticity is the *Engel's law*, which states that the proportion of income spend on food declines as income increases (referring to expenditure in terms of shares of income spent on food and not actual consumption). He observed in the mid-19th century that poor families spend a greater proportion of their total expenditure on food compared with their richer consumers. The more a household's income increases, the less income (in percent) the household spends on food (Clements and Si 2018). This is shown in Figure 2.2 with UK data from the Living and Costs and Food Survey.

Figure 2.2 Relationship of income to consumption of breakfast cereals and the share of income spent on food and non-alcoholic drinks in the UK.



Source: Own elaboration from DEFRA, disposable income deciles from the Living Costs and Food Survey Technical Report for survey year April 2015 to March 2016

Figure 2.2 illustrates the purchases of breakfast cereals in the United Kingdom across income deciles. Consumption and income are presented as 3-year averages, 2015-2017. The first decile represents the lowest incomes, and the tenth decile the highest income. It shows that the lowest income deciles consumed about 100g on average per week per person compared to 140g in the highest decile. The orange line represents the income spent on food and non-alcoholic drinks in general across income deciles underlining that the lowest deciles invested about 20 per cent of their disposable income on food and drinks whereas the highest deciles spent 6 per cent of the income. Therefore, promotions and price reductions and the likelihood of buying food on promotion is directly proportional to the share of income spent on food. This is of key interest for this study knowing that the role of promotions goes beyond marketing and psychological influences but also has a direct impact on the income.

2.5. The food category of breakfast cereals

The importance of eating breakfast is widely discussed in the literature, because eating breakfast is considered a critical component of a healthy diet and breakfast cereals are part of it. Breakfast is not only important for adults but also plays a key role for children and adolescents. Promoting breakfast as part of healthy dietary patterns in children is crucial but also parental breakfast habit is strongly correlated with the breakfast consumption of their children (Reeves et al. 2013; Coulthard et al. 2017). Hence this study improves the understanding of UK breakfast cereal purchases and who buys which breakfast cereals especially regarding different household compositions. Breakfast cereals are a common way to start the day as they are quickly prepared and convenient, however breakfast is more

commonly missed than any other meal of the day (Mullan and Singh 2010). In the literature, studies have been conducted on breakfast cereals due to the importance as a first meal of the day and as a source of key nutrients e.g., whole grain cereals or high in fibre cereals. Moreover, this category is significant in the diet due to the wide range of consumption across all consumers – from young children to elderly people all over the world (McKevith and Jarzebowska 2010; de la Hunty et al. 2013; Williams 2014; Potvin Kent et al. 2017b).

Gaal et al. (2018) conclude that among UK adults, "a cereal based breakfast has been associated with significantly lower intakes of total fat, saturated fatty acid and non-milk extrinsic sugars and higher intakes of protein, carbohydrate, fibre, B vitamins, vitamin C, D, calcium and iron in comparison to a non-cereal based breakfast or no breakfast". Consumption of ready-to-eat breakfast cereals (RTEC), especially fibre-rich or whole grain products, is correlated with several beneficial nutritional and health outcomes, however a higher total sugar intake has been associated with frequent RTEC consumption (Priebe and McMonagle 2016). There are various reasons why this study focusses on the breakfast cereal category and the main justifications and reasons to analyse breakfast cereals in this study are described in this section.

2.5.1. Consumption of breakfast cereals in the United Kingdom

According to Kantar Worldpanel research (2019), British consumers eat 5.9 times breakfast at home and 60 per cent of it involves cereals. Breakfast cereals account for 34 per cent of consumption. In 2017-18, British consumers ate 5 per cent more ready-to-eat cereals and 4 per cent more hot cereals, but granola consumption declined by 8 per cent. Sales increased on products like cereal bars (2.2% growth to £444.5 million), porridge (up 4.8% to £247 million) and marginally on ready-to-eat cereal (value of sales is up 0.7% to £1,318.1 million) (Lovell 2018). High consumption of breakfast cereals has been found in the United Kingdom. In 2018, an estimated 15.8 million people used Kellogg's products in Great Britain and ranked second and third were Nestlé and Weetabix (Statista Research Department 2020).

Not only is this food group one of the largest categories in the retailer, but it is also a widely discussed topic. The UK government recommended policy implications to reduce sugar in a UK-wide "Sugar Reduction Programme" including breakfast cereals which aims at reducing 20 per cent of sugar in breakfast cereals products targeted at young children by 2020 (UK Government 2016). Besides that, the change in eating habit towards increased eating-out behaviour also impacts breakfast and the need for products that adapt to more convenient and on-the-go products. Part of the category is also the increasing packaged food consumption and convenience food which includes breakfast cereals such as ready-to-eat porridge boxes. Another development is the negative media coverage of ultra-processed foods in the UK making up to 50.7 per cent of the British food consumption, which includes breakfast cereals and the subcategory ready-to-eat cereals (RTEC) tend to be highly processed (Devi et al. 2014;

Costa-Font and Revoredo-Giha 2019). This underlines the relevance and importance of this category in the context of a UK study focussing especially on Scotland.

2.5.2. Variety in breakfast cereal products and healthiness

The cereal industry is a combination of a small number of national brand manufacturers, a few small producers, and a large number of private labels (Golub and Binkley 2005). The categories are broad in terms of ready-to eat cereals but also include subcategories such as oats and granola and therefore offer a wide variety and range of products. The breakfast cereal category in this study analyses Kantar Worldpanel data offering a wide spectrum of products of 1,122 products across 52,000 purchases in 2015. Part of the recent development in the breakfast cereal category is the rise of private label cereals compared to the traditional national brands, which has been seen through new strategic methods such as new product innovation, product formulation and new promotion tactics. A study by Costa-Font and Revoredo-Giha (2019) underlines the broadness of this food category through the new product launches: 2262 new breakfast cereals launched in different types of retail stores between 2000 and 2019 by 282 manufacturing or retailing companies using 700 different brands.

The large range of products consists of private label breakfast cereal products. These target different consumers offering quality for a lower price and cut down cost through not using marketing strategies. Constant share growth among the private label breakfast cereals is evident. According to the IRI market research report from 2018 about private label found that in the United Kingdom the private label share is highest across Europe (52.5%) but also growing the most. The private label share grows for the fourth consecutive year, possible reasons being that consumers switch from branded to private labels due to lower costs but also due to further development of premium ranges (IRI 2018). Another important development in the breakfast cereal category is the premiumisation, especially among private label brands. It means that some brands increase the quality of their products through special ingredients and are identified by the consumers as higher quality and increased worth.

Breakfast cereals as a category include a wide range of associated healthiness across products. The spectrum goes from sugary cereals to the other end with unprocessed oats. Breakfast cereals is one of the largest retail category and therefore contains a range of products varying in nutritional quality – on the one hand cereals are an important source of whole grains and fibre, but on the other hand highly sweetened cereals are often criticised for their nutritional composition and for targeting children (Golub and Binkley 2005). Therefore, this study includes these key components within a nutrient profiling model which that has been applied in this study. To further investigate the consumption of breakfast cereal, a study pointed out that due to the large competition of the manufacturers healthy and less healthy products can be bought in low- and high-priced versions. Interestingly, the common belief is that healthy products are in general more expensive, but it is the contrary in the breakfast cereal category; the cheapest are the ones that are mostly unprocessed for example shredded wheat and these

are also the healthiest because processing grains leads to a reduction of the nutrition inside. On average, the less processed breakfast cereals are the healthier and cheaper ones, also because they need fewer ingredients and are therefore easy to duplicate by private label brands (Binkley and Golub 2011). This can also be found in the Kantar Worldpanel data set used in this study. The following table (Table 2.1) shows the price differences among healthy and less healthy products (in GBP).

Table 2.1 Price differences among (less) healthy Kantar Worldpanel breakfast cereal products.

Product name	**Weight**	**Full price**	**UK FSA**
Tesco Porridge Oats	1000 g	£ 1.20	Healthy
Tesco Malt wheats	750 g	£ 1.90	
Sainsbury Porridge bag	1500 g	£ 1.70	
Kellogg's Frosties	750 g	£ 2.60	Less healthy
Kellogg's Crunchy Nut Cornflakes	1000 g	£ 4.00	
Nestle Cinnamon	565 g	£ 3.49	

Source: own elaboration based on Kantar Worldpanel data from 2015

These less healthy sugary cereals have been recently put on the discussion table across governments and manufacturers and government are taken this into consideration. Li et al. (2018) mention that cereal manufacturers have already reacted to this criticism through product reformulation for example by an increase in fibre and a decrease in the sugar and sodium content in order to improve the nutritional quality. From 2006 to 2012, cereal manufacturers have engaged in product reformulations by reducing sugar and sodium and increasing fibre content.

Breakfast cereals, from a nutritional point, offer numerous benefits because they are often low-fat, but nutrient-dense being a good source of carbohydrate, fibre, protein, and providing valuable micronutrients such as iron, and vitamins such as B, D and E (McKevith 2004; Barton et al. 2005; Aisbitt et al. 2008). Furthermore, the population who consumes breakfast cereals lives healthier and eating breakfast cereals regularly leads to a more nutritionally balanced diet in general as well as having a positive effect on the body mass index (BMI) – which is lower compared to non-breakfast-cereal eaters (Aisbitt et al. 2008; McKevith and Jarzebowska 2010; Mullan and Singh 2010).

De La Hunty et al. (2013) examine the role of breakfast cereals on the diet and find out that a regular consumption of breakfast cereals results in a lower BMI compared to those consuming breakfast cereal irregularly. Besides, a reduced probability of overweight and obesity is documented among the regular consumers. This finding can be linked with studies by Galvin et al. (2003) and Gonzalez-Vallejo and Lavins (2016) who state that the consumption of breakfast cereals improves the dietary intakes due to its composition of carbohydrates, fat and fibre and its micronutrient-dense diet. As concluded by

Mullan et al. (2013), consumers with lower socio-economic background are more likely to skip breakfast as well as females compared to males across all age groups. However, unhealthy breakfast cereals have been criticised in the existing literature (McKevith and Jarzebowska 2010; Potvin Kent et al. 2017b). Research has shown that for some breakfast cereal products the nutritional intake is poor due to a high number of calories derived from sugar which can increase the risk of obesity. Moreover, high amounts of salt and saturated fat have been found in some products. Li et al. (2018) look into US breakfast cereal products and their attributes and find that health-related attributes have an impact on consumers' purchase decisions: consumers also are less responsive to changes in the price when the cereals have a high content of sugar and fat, which often fall into the less healthy category.

This recent development shows the necessity for defining healthiness of food products in order to give product specific information. Binkley and Golub (2011) mention the difficulty of measuring the healthiness of breakfast cereals. Fibre and sugar are the most important nutrients to investigate and their study utilises an index similar to the UK FSA score which includes sugar, fibre, protein, fat and sodium. A number of studies have followed the same approach to categorise healthiness using the UK FSA nutrient profiling score and it is a common practice to use the UK FSA Score to assess the healthiness of breakfast cereal (Devi et al. 2014; Maschkowski et al. 2014). In the same spirit with the earlier research, this study will use this method to assess the healthiness of breakfast cereals, which is explained in Chapter 3.

2.5.3. Marketing and retail promotions for breakfast cereals

Breakfast cereals have been studied especially in the marketing and economics field because it is characterised by high introduction of new products, high price-cost margins and advertising costs, as well as high concentration ratios (Empen et al. 2015). These products are highly marketed and promoted from the manufacturers as well as from the retailers and target both adults and children. For example, Kellogg Company, the leading manufacturer of breakfast cereals and other convenience food products, reported in their annual report expenditures of USD 676 million on advertising in 2019 (Kelloggs 2019). The food category breakfast cereals has various characteristics and attributes that affect the consumption behaviour. Attributes such as the package size, the branding and the health status are key characteristics, and all used for promotional purposes. Variations in food packages are part of applied marketing strategies and are an important component of integrated marketing campaigns designed to influence the consumers not only at the point of purchase but also during consumption at home (Mediano Stoltze et al. 2019).

Evidence shows that food marketing is four times more applied to less healthy foods and beverages on television, to stimulate not only the adults but also the children resulting in an increase in consumption of the advertised products (Vermote et al. 2020). The role of children in breakfast cereal advertising is unique and studies have examined this. Breakfast cereals are among all food products one

of the most frequently marketed to children in order to influence children's food preferences and therefore leading to increased purchasing and purchasing requests towards for instance the parents (Sparrman and Cook 2009; Mediano Stoltze et al. 2019; Vermote et al. 2020). On television, high-sugar ready-to-eat cereals (RTEC) are the most frequently promoted in child-targeted food advertising of packaged foods. For example, children viewed 1.7 advertisements per day for ready-to-eat cereals - 87 per cent of those have promoted high-sugar products. As a comparison, adults viewed half as many advertisements promoting equally high- and low-sugar cereals. Interestingly, the high-sugar ads included unrealistic and contradictory messages about cereal attributes and healthy eating that have been viewed by children (LoDolce et al. 2013). Further marketing strategies dealing with the package and design are implemented such as breakfast cereals with "insert toy" but also use licensed or branded characters to attract the attention. Also, displays of claims and the use of promotional characters on the Front-Of-Pack of Cereals, where the majority of promotional characters was used on 'less healthy' breakfast cereals (Vermote et al. 2020).

The retail environment and supermarkets, where the largest proportion of food expenditure is made, influence the purchasing and consumption patterns in-store and additional marketing strategies are applied going beyond the packaging that is influenced by the manufacturers. In-store promotions are important from a retailer perspective because evidence shows that two thirds of food purchase decisions are made while the consumers are shopping (Potvin Kent et al. 2017b). One example is that the retailers have an influence on the positioning of the products in the aisle and shelves. Evidence shows that in Canadian retailers less healthy cereals are displayed at an eye level, in the middle shelves and also 2.9 times more frequently than healthier cereals, all impacting sales of less healthy products positively. They also showed that less healthy breakfast cereals were found more at end cap and midaisle displays and also had more special pricing signages compared to healthier products. All of these strategies make it more likely that the consumer will purchase the products aligned with their line of sight and grab their attention towards e.g. temporary products that are on promotion shown in a display, and therefore the supermarkets seem to encourage the purchase of less healthy breakfast cereals (Potvin Kent et al. 2017a). Not only the location and the positioning of products in-store influence the purchase behaviour, but another example are the retail promotions applied to the price and they play an important role: in the UK, 40 per cent of the products are purchased with an applied promotion to the price. The food subgroup Ready-To-Eat-Cereals (RTEC) had the highest proportion of price promotions compared to all other categories used in their research, which were 45 per cent in 2012. The study found an increase in the prevalence of price promotion purchases comparing 2008 and 2012 and the least prevalent price promotions have been found for fruit and vegetable purchases (Taillie et al. 2017).

The importance of this food category is highlighted by recent UK government plans: The sugar reduction plan and the impact assessment about restricting volume promotions for HFSS both include the food category breakfast cereals in their plan to ban volume promotions applied to these products based on their analysis of UK Kantar Worldpanel data (Smithson et al. 2015; Government 2020b).

To conclude, this section underlines the importance of investigating the category breakfast cereals which can, based on literature, influence the healthiness of the population when eating the appropriate and healthy breakfast cereals regularly, but can lead to obesity when consuming the unhealthy products. Moreover, the prevalence of obesity and skipping of breakfast was higher among people with a low socio-economic background (Hulshof et al. 2003). The high consumption of breakfast cereals in the UK, the importance of the ultra-processed foods, and the marketing strategies applied from manufacturers and retailers on breakfast cereals make it an interesting food category to study. Moreover, the category offers a great variety of products across healthiness and brands. As the systematic review from Priebe et al. (2016) including 64 publications, shows that a considerable number of studies have investigated the impact of the consumption of breakfast cereals on nutritional and health benefits, however few have included the role of retailer promotions on the consumption. This study investigates this link using Kantar Worldpanel purchase data, which provides great detail about the category breakfast cereals, their nutritional intake as well as information on various socio-economic characteristics of the households who purchase them. But it adds as the promotion applied by retailers and also the type of promotion to the analysis. Few studies deal with breakfast cereals and the gaps are highlighted in Table 2.2. While Kent et al. (2017) use data collected at retail level in-store, Li et al. (2018) and Binkley and Golub (2011) use scanner data collected at the household level. Further, the comparison shows that the type of analysis differs from descriptive statistics to regressions or AIDS demand models. Table 2.2 underlines the current state of the literature and the different characteristics of the studies all related to breakfast cereals.

Table 2.2 Literature gaps in breakfast cereal studies.

Author	Analysis	Data type	Unit of analysis	Variables used
Golub and Binkley (2005)	Regression	US AC Nielsen Homescan database USDA food nutrition data	Household-level purchases linked to product-level nutrition data	Healthiness by USDA food nutrition data Demographic characteristics of households Brand / private label
Thunström (2010)	Mixed multinomial logit model	Household panel data 'Growth from Knowledge' (GfK) Sweden nutritional content by Swedish National Food Administration (SLV)	Household purchase data	Habit persistence Nutrition symbol Keyhole
Devi et al. (2014)	T-test and chi-square test	Cross section data collection in NZ in 2 supermarkets of details of all breakfast cereals available for purchase (nutrition information and front-of pack)	Product	FSANZ Health Claims NPSC Nutrition and health claims Promotional packaging
Potvin Kent et al. (2017b)	Descriptive Statistics	Sample collected in-store over 4 weeks in Canada (Ottawa)	Product	UK FSA Frequency of in–store promotions
Li et al. (2018)	LA/AIDS DM demand model	US Nielsen Homescan purchase USDA's National Nutrient Database for Standard Reference	Household-level purchase data matched with product-level nutrition data	Household-level demographics Nutrition composition
Costa-Font and Revoredo-Giha (2019)	Descriptive statistics and hazard-based duration models	Kantar Worldpanel Dataset (KWDS) and Mintel Global New Products Database (GNPD)	Information on products launched linked to household purchases	Nutrition and health claims New launched BC

2.6. Relevance of Scotland

In this thesis, Scotland can be seen as a case study representing the above-mentioned components of the literature background. Scotland as a case combines the obesity problem, the less healthy food consumption of ultra-processed foods but also the role of retail promotions, which has been analysed by the Scottish government.

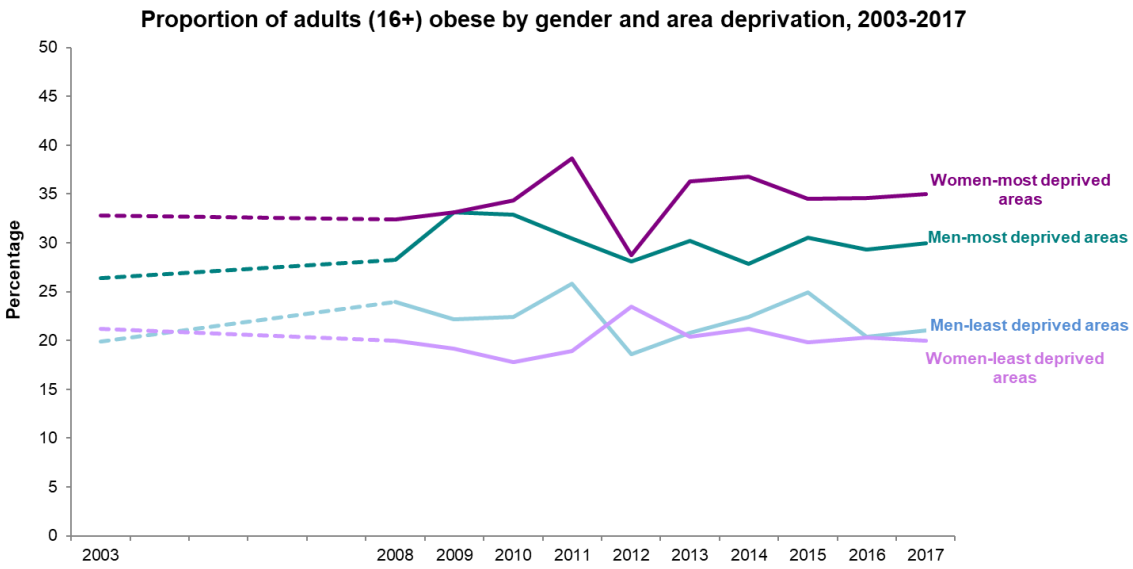
In the United Kingdom in 2015, 63% of adults are overweight and about 26% are obese and the rate for childhood obesity is about 28% (UK Government 2017). Comparing this to Scotland, the facts are even worse: 65% of adults being overweight and obese and 29% of adults being obese. Based on a Scottish report, the rate for childhood obesity is 31% (Scottish Government 2019). In Scotland, the percentage of food energy contributed by free sugars (14.4%) remained higher than the Scottish Dietary Goal of less than 5% of energy (2015) and only 24% of the Scottish population manages to eat 5-a-day of fruit and vegetables. Including the role of promotions, it underlines why Scotland is used as a case study: 40% of food and drinks have been bought under promotion, however half of the less healthy foods are bought under some kind of promotion in the supermarket. Moreover, a recent report mentions that the proportion of baskets bought on promotion is broadly similar across all English regions and between England, Wales and Scotland therefore the Scottish sample in this study provides great insights informing about several parts of the United Kingdom (Coker et al. 2019).

Overweight, obesity and unhealthy diets

Scotland has one of the highest obesity rates across OECD countries with a diet estimated to be 40% over the Scottish dietary goal of energy density (Scottish Government 2019) and two third of adults being overweight or obese in 2017 and 29% of the children in Scotland (FSS 2020). It has been predicted that by 2030, 40% of the Scottish population might be obese (Scottish Government 2019). The following section is based on several reports from the Scottish Government "Preventing Overweight and Obesity in Scotland" (2010), The Scottish Health Survey (2019), Food Standards Scotland (2015), and NHS Health Scotland (2015).

According to a Scottish Government report the factors that influence adult overweight and obesity and are strongly associated with BMI are physical activity, sedentary behaviour and diet, which will be investigated in this study. The report finds that obesity among women is significantly associated with the level of deprivation, which specifically in Scotland is called Scottish Index of Multiple Deprivation (SIMD) and will be explained in the section 3 on data.

Figure 2.3 Proportion of adults obese by gender and area of deprivation in Scotland.



Source: Scottish Government (2019)

Figure 2.3. underlines the importance of the socio-economic background when examining unhealthy food consumption and obesity rates and it shows the gaps between women in most and least deprived areas and men in most and least deprived areas. This dataset is rich having SIMD data detailed deprivation level which is included in the analysis. The role of childhood obesity is important as well and it has been found that children with an obese parent are significantly more likely to be at risk of being overweight and obese. Besides, boys in the lowest income households are more likely to be obese compared to other households.

According to the Scottish Health Survey 2019, Scotland's unhealthy diet is one main cause of the obesity crisis. Problematic is that the poor diet has not changed significantly in the last 17 years even though 91% of the Scottish population and the Government are aware of the existing obesity problem (Scottish Government 2019). According to a Food Standards Scotland report (2015), a characteristic of the Scottish diet is not only the lack of fruit and vegetables but also is the diet too high of fat, sugar, calories and salt. A lack of fruit and vegetable in the Scottish diet underlined by the fact that around one quarter (24%) of adults consumed five portions a day of fruit and vegetables in 2017, which is recommended by the World Health Organisation (WHO). The average was 3.3 portions a day for adults and 2.9 portions among children. Research has shown that younger Scottish people's diet falls below the national recommendations. The link between poor diet rich in saturated fat but low in fruit and vegetable intake and the risk of various diseases such as cancer, cardiovascular disease and type 2 diabetes is well established in the literature (Scottish Government 2019). A report of the Scottish Government on Obesity prevention (2010) estimates that the NHS costs for Scotland for obesity will

almost double by 2030. Based on the Scottish Health Survey from 2019 the Scottish Dietary Goals offer a basis for a healthy balanced diet and they include (Scottish Government 2019):

(i) The World Health Organisation 5-a-day recommendation for adults (to consume at least five varied 80g portions of fruit and vegetables per day).

(ii) Reduced salt intake from around 9g to 6g per day for adults.

(iii) Reduced average calorie intake by 120 kcal per day and average intake of red meat to 70g per day.

(iv) Advice on limiting fat and sugar intake and increasing consumption of fibre and oil-rich fish.

(v) Reduced the average intake of free sugars to 5% of total dietary energy.

(vi) Increased intake of dietary fibre to 30g per day for adults.

(vii) Maintained intake of starchy carbohydrates at 50% of total dietary energy.

Having seen the link between obesity and the level of deprivation in Figure 2.3 it is important to further connect the level of deprivation to the purchases and food consumption. Households in the most deprived SIMD areas purchased a higher proportion of their total calories from confectionery, regular soft drinks and bread compared to the least deprived areas. Purchases from households from the least deprived areas were characterised by a higher proportion of their total calories from cakes and pastries, plain starchy carbohydrates, oil-rich fish and fruit and vegetables compared to those from the most deprived areas (FSS 2020).

The Scottish diet is too high in fat, sugar, calories and salt and evidence shows that discretionary foods are frequently consumed and have a significant negative impact on the Scottish diet, providing 20% of calories, 20% of fat and 50% of sugar. In order to reduce population-level intakes of calories, fat, free sugar and salt, the Scottish Government is considering restricting the in-store promotion and marketing of discretionary foods.

Retail promotions and implication for policy

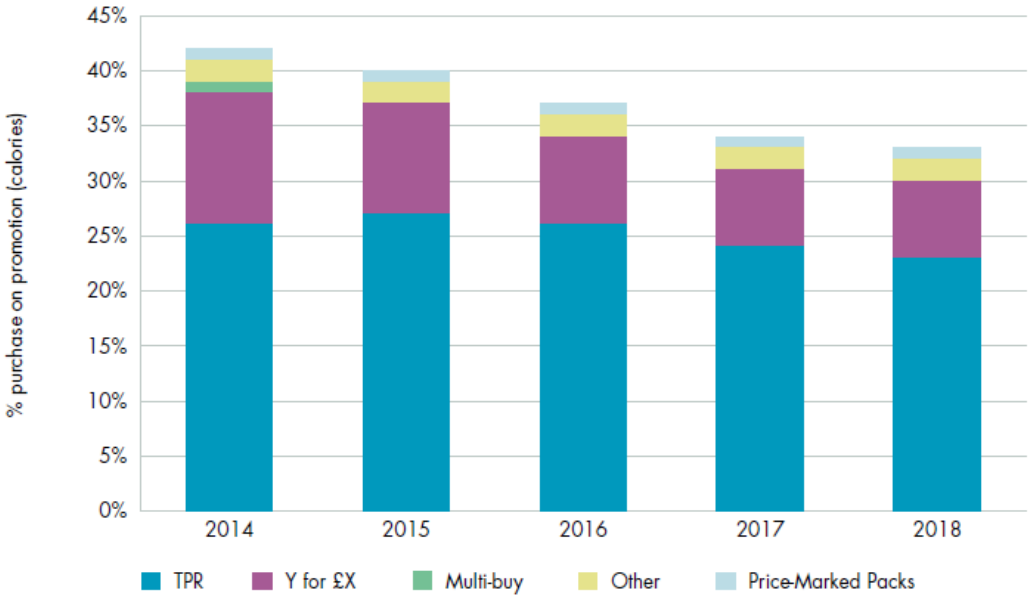
As mentioned above several reports by the Scottish Government mention the role of marketing on less healthy products and HFSS foods playing a significant role in the dietary choices especially among children and young people of Scotland.

In Scotland, the different types of promotions are crucial to investigate as well; temporary price reductions are the most prevalent kind of promotion, accounting for around 74% of promotions whereas multi-buy promotions represent around 23% of promotional activity in Scotland. However, multi-buy promotions tend to be more regularly used for food and drink high in fat, salt, and sugar (Martin et al. 2017). Another Scottish report by the Scottish Government examined retail purchases and price promotions (FSS 2020). An analysis of Kantar Worldpanel data from 2010-2016 on promotion types

shows total calories purchased under temporary price promotion increased from 21% in 2010 to 26% in 2016. The promotion type "Y for £X" shows declined calories purchased from 13% to 8% during the same time period. However, "Y for £X" and "multi-buys" are less prominent among healthier and less healthy categories now compared to 2010. The relationship between spend per kilogram and promotions has been found on products bought under promotion being more expensive than products bought under no promotion in certain categories such as dairy desserts and ice cream (Campbell et al. 2020). An underlining example from the Kantar Breakfast cereal dataset used in this study is the comparison between the price of 1 kg Tesco Porridge Oats under no promotion £1.20 and the 1 kg Kellogg's crunchy nut cornflakes under promotion for a price of £3.00 (reduced from a full price of £3.99).

A comparison of retail promotions in Scotland from 2014 to 2018 (Figure 2.4) shows that since 2014, temporary price reductions (blue bar chart) have remained the most common promotion type and accounted for 23% of all calories purchased in 2018. The Y for £X promotion type has declined from 12% of calories purchased in 2014 to 7% in 2018, and multi-buys fell from 1% to nearly zero (Campbell et al. 2020).

Figure 2.4 Percentage of calories purchased with a retail promotion by promotion type in Scotland.



Source: Campbell et al. (2020)

Around 40% of the food and drinks purchased in supermarkets are on a price promotion and are more prevalent on unhealthy foods e.g., up to 74% of confectionery has been purchased under promotion. Moreover, half of the unhealthy foods such as crisps, savoury snacks were bought and 40% of confectionary and desserts was bought under a price promotion in 2016 and 2018. Purchases made under promotion continue to be skewed towards less healthy categories meaning that higher purchases

have been made of less healthy foods on promotion, compared with healthier foods, for 2016 and 2018. A recent study by the Scottish Government (2016) reports that 50% of the less healthy products are bought on promotion. For some less healthy categories more than 50% were purchased on price promotion, compared with less than 30% for some of the healthier categories (McDonald and Milne 2018). However, none of these studies looked at price and volume promotions separate but rather combined the temporary price reduction and multi-buy in the Kantar Worldpanel dataset and compared on versus off promotions.

Less healthy foods have been more frequently purchased under a supermarket promotion (43%) compared to healthy food (27%) and was generally similar across most traditional retailers whereas discounters had more balanced purchases under promotion of health and less healthy foods and in some cases even higher purchases for healthier categories. An example of one food category "confectionery" shows the average purchase on price promotion was 68% on traditional retailers compared to 10% among discounters (McDonald and Milne 2018). Only 20% of fruit or vegetables have been under price promotion (FSS 2020).

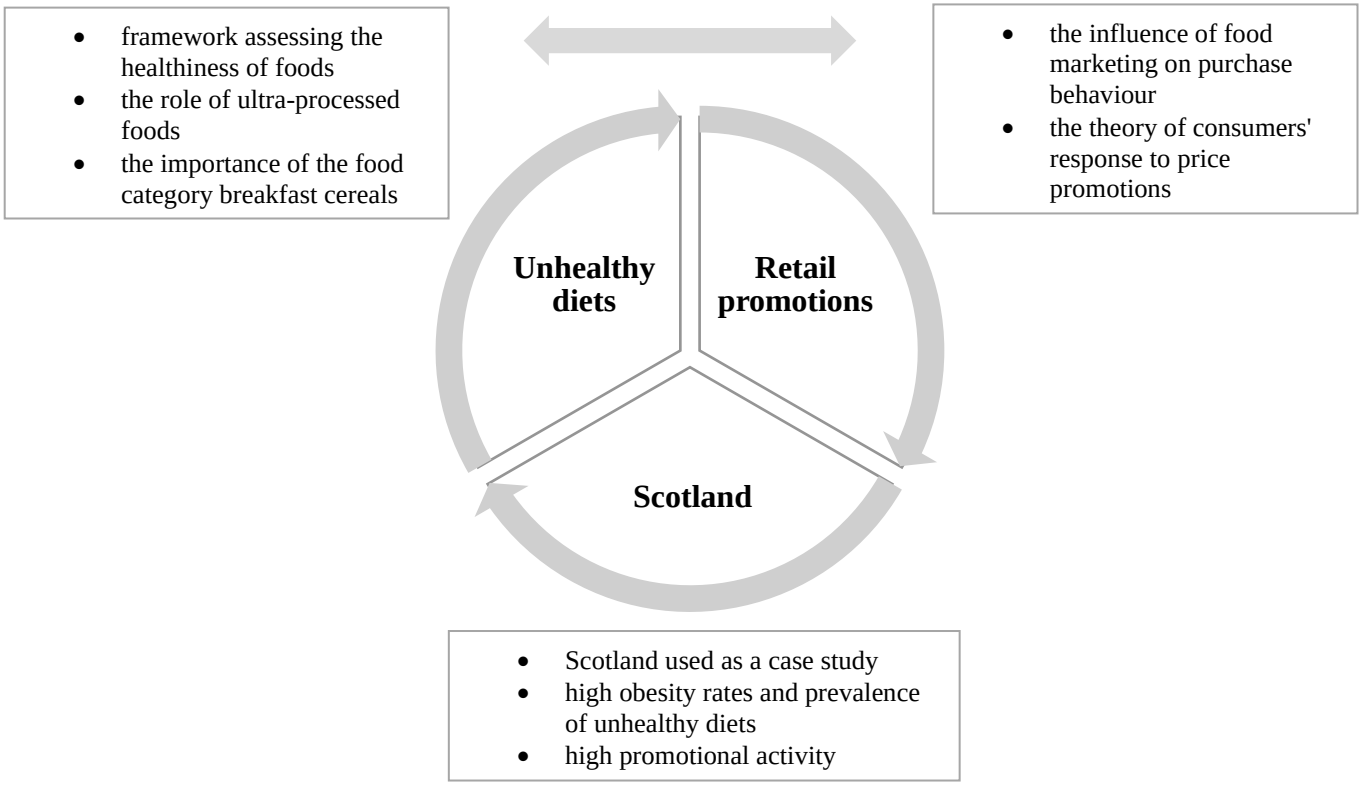
Further, the report gives information on retailer structure in Scotland. Tesco, Asda, Morrisons, the Co-operative, Sainsbury's, Aldi, Lidl and Marks & Spencer contributed to 88% of total take home spend (Campbell et al. 2020). Traditional supermarket chains such as Tesco and Asda, record purchases under price promotion from 36% to 45% contrasting to purchases made in discounters being only 11%. Interestingly, in discounters and Sainsbury's Y for £X and multi-buys promotions were absent or recorded very low. However, Campbell et al. (2020) finds that among the main eight retailers in Scotland, purchase on price promotion ranged from 7% to 44% in 2018 and varied considerably by retailer, for instance purchases with a price promotion on confectionary ranged from 74% in one of the retailers to only 6% in another. This highlights the difficulty of comparing results not just among countries and different food categories but even among retailers within the same country and the same food group.

The Scottish Government considers several plans to tackle the obesity crisis which have been complemented by action plans at UK level such as various chapters of the UK Government's Childhood Obesity Plan. One possible policy is to restrict the promotion and marketing of discretionary foods where they are sold to the public to reduce the volume and frequency of their purchase and therefore reduce the associated health harm of their consumption. Based on a Scottish Government consultation paper (2018), the restriction of promotions and marketing of foods and drinks high in fat, sugar or salt where they are sold to the public are considered and pushing for a bill on Restricting Foods Promotions. It includes the restriction of multi-buys and the sale of unlimited amounts for a fixed charge. However, it does not include restricting temporary price reductions and multi-packs (defined as two or more items in a pack sold as one item). Another report by the Food Standards Scotland (FSS) mentions the plans to restrict promotions and marketing on discretionary foods to remove the triggers in supermarkets, which encourage consumers to these purchases (Griesbach and Waterton 2018). Another plan and new

measures included in the new Scotland's Diet & Healthy Weight Delivery Plan include restricting multi-buy deals including meal deals, free samples, upselling and loyalty schemes. Moreover, the Scottish Government will also explore restrictions on for example displays at checkouts, end-of-aisle, and front of store.

All in all, this literature review highlights the gaps in the current state of the literature especially analysing retail promotion types and the use of promotions from the retailer side but also from a consumer side. Based on the evidence of the growing obesity crisis linked to a less healthy diet, the retail environment in the UK and Scotland, and the role of promotions the research question arises whether the influence of retail promotions can improve diets and if further evidence can be found whether promotions can encourage healthier eating habits. The results will therefore contribute to the discussion whether promotions in the supermarket can lead to healthier diets if they are applied by the retailer and purchased by the consumers. The theoretical framework underpinning this research is linked to the theory of consumers' response to price promotions and how they influence consumer behaviour as well as a framework to assess unhealthy diets and the healthiness of products as shown in Figure 2.5.

Figure 2.5 Theoretical engagement underpinning this research.



The literature review on retail promotions but also the link to breakfast cereals and Scotland highlights the need for and importance of this thesis and the theoretical framework underpinning this research is shown in Figure 2.5. The thesis tries to answer the question whether retail promotions can improve diets and whether it finds evidence that promotions will lead to healthier breakfast cereal purchases. However, there are some inconsistencies and gaps in the literature in explaining the influence of retail promotions in terms of healthy and less healthy food consumption patterns, which need further research especially among the influence across different promotion types. This thesis addresses these gaps by including different promotion types as well as assessing the healthiness of each product in the analysis. Several other studies mention the need to disaggregating categories by type of promotions for example (Revoredo-Giha et al. 2018; Kaur et al. 2020). To the author's knowledge, this thesis is the first of its kind to investigate across promotion types the healthiness of products looking at product-level data and household-level data. Assigning a health score for each product in the dataset provides an extra insight when splitting the dataset and comparing healthy and less healthy products and still indicating the degree of healthiness per product. Table 2.3 highlights the key areas of research in each of the relevant study.

Table 2.3 Relevant studies for this thesis.

Author	**UK / Scotland**	**Scanner data**	**Breakfast cereal**	**Promotion types**	**Product healthiness**	**Socio-economic groups**
Bogomolova et al. (2015)	✓	✓		✓		
Binkley and Golub (2005)		✓	✓		✓	✓
Costa-Font and Revoredo-Giha (2019)	✓	✓	✓			
Nakamura et al. (2015)	✓	✓			✓	✓
Revoredo-Giha et al. (2018)	✓	✓				✓
Li et al. (2019)		✓	✓		✓	✓
Taillie et al. (2017)		✓			✓	✓
Powell et al. (2016)					✓	✓
Riesenberg et al. (2019)					✓	
This study	✓	✓	✓	✓	✓	✓

To conclude, the majority of relevant prior studies in this research thesis can be grouped into two main subject areas and will be analysed separately across each research questions: (i) studies on the role of promotions across the healthiness of products from a retailer perspective using product-level data in Section 4.3.4 and (ii) studies on the influence of promotions across the healthiness of products on the consumer side using household-level data in Section 5.2.5.

2.7. Conclusion

This chapter provides a review of the literature on the obesity crisis, unhealthy diets and the influence of marketing on food purchases, combined with the role of promotions from the retailer's and consumer's perspective. Further, the importance of the food category breakfast cereals is discussed and why it was chosen for this thesis. Moreover, it introduces Scotland as a case study and justifies the reasoning to use it as a setting for the research. Overall, it is important to stress that this thesis is dealing with a case study of Scotland and the breakfast cereal category alone, and therefore no generalisation can be made on the full diet.

To conclude, the overall knowledge gaps for this thesis are on the one hand based on the content and variables included in this study but on the other hand based on the data used in the analysis. The current state of literature on the research areas of promotions and on healthiness of products linked to socio-economic groups can be categorised across different levels; mainly either based on product-level

analysis or household-level analysis. Retail-level data (often product-level) is not always available but it would be more complete to investigate promotional offers and availability within a market. Beyond the use of retail data to analyse price promotions, some researchers use panel supermarket purchasing data to investigate the influence of promotions further. More common across the literature is the analysis of household-level data using for example scanner data from market research companies such as Nielsen, Kantar Worldpanel or GfK. It is an advantage when studying household structure and socio-economic characteristics of households and how they affect consumer decisions. However, a disadvantage of household-level data on food purchases is that it is censored due to the fact that households only purchase a small subset of available products or brands. However, some detail orientated studies that deal for example with a specific food category are linked to cross-section in-store data collection that requires for example nutritional values in order to include the healthiness of each product. Possible scanner data types used are from AC Nielsen (often used in the United States) or Kantar Worldpanel (mainly United Kingdom), lead to research with detailed data on product, household, shop information. However, studies need to aggregate data which inevitably leads to missed detailed information on for example product or household characteristics, which are of great importance for research on food demand.

Chapter 3

3. Data elaboration

3.1. Introduction

As Chapter 2 sets out the research context and reviews the existing literature, it was made clear the role played by marketing and promotions on the increasing consumption of less healthy foods especially under the light of the current obesity crisis. This chapter aims to present a general overview of the data and to highlight its suitability as well as novelty for the current research. Specifically, this study analyses specific subsets/cuts of the whole Kantar Worldpanel data and focuses on the food category breakfast cereals representing a part of the ultra-processed food category. As mentioned earlier, Scotland is used as a case study with a population having unhealthy food consumption patterns and a higher rate of obesity in adults and children than the average figure of the United Kingdom. A novel contribution of this research is the use of a nutrient profiling score to assess the degree of healthiness of each breakfast cereal product. To this purpose, the UK Food Standards Agency (FSA) Nutrient Profiling Model has been selected as a measure of healthiness. Critical developments of the model will be mapped out. A new dataset with a health score has been created, in order to match it with the analysis of purchases and household information from the Kantar Worldpanel purchase data.

This chapter also describes the nature of the data being used along with the relevant definitions and the separate components that have been merged to construct the final database. Depending on the research question, the data can be characterised by two dimensions: over (i) products and (ii) households, thus it can be disaggregated into two datasets to address the research questions representing the supply-side orientation through product-level and demand-side orientation through household-level. Details about these datasets will be provided in the empirical chapters. The rest of the chapter is organised as follows. Section 3.2. presents the single data components. Section 3.3. elaborates how the final dataset has been constructed and aggregated. Section 3.4. discusses the nature of the data and 3.5. elaborates the description of the purchase database, whereas section 3.6 concludes.

3.2. Data components

The following section presents the description of the data components in this study and includes brief descriptive statistics of the Kantar Worldpanel data on products, the shops, the households, but also includes a description of the database.

3.2.1. Kantar Worldpanel Dataset

This study analyses a secondary data source, the Kantar Worldpanel data including barcode-specific supermarket purchases of food of around 3,000 representative households across Scotland in 2015. The data contains weekly information at the household level about prices paid, whether the product was purchased under promotion, the quantity purchased, as well as socio-economic and demographic characteristics of the households. The participating households are issued with a hand-held scanner with that they record every single item purchased in a supermarket and brought home. In addition, till receipts are used to provide information on prices and place of purchase. The data gives therefore accurate quantity, expenditure and summary description information of every item purchased. Based on the sample size, the data offers a representation of Scottish take-home purchases however it should be emphasised that the data only represents purchases in retailers and excludes food purchased out of home or from takeaways, which accounts for 20-25% of calories consumed (Campbell et al. 2020). Overall, it includes 52,524 purchases with 1,122 products, 57 shops and 2,775 households.

Kantar Worldpanel Dataset: Product information

This analysis deals with the food category of breakfast cereals as part of the whole Kantar Worldpanel dataset, which includes all purchases made in a shopping basket of each household. The products used in this research belong to the breakfast cereals category and they have been studied especially in the marketing and economics field due to the high introduction of new products, high price-cost margins and advertising costs, as well as high concentration ratios (Empen et al. 2015). Moreover, breakfast is considered the most important meal of the day and plays a significant role especially for the younger population. Breakfast provides a higher percentage of micronutrients than other meals and when being consumed regularly it has been linked to improvement in academic performance and a healthful lifestyle (Affenito 2007).

In the United Kingdom, consumers can choose from over 2,000 breakfast cereal products across subcategories such as porridge oats, ready-to-eat cereal, granola or muesli, which are all recorded in the Kantar Worldpanel data. The Kantar Worldpanel dataset includes information on 1800 households (in 2015) that bought breakfast cereals in the years from 2006 to 2015. The information on the purchases made by the households include for instance the average weekly expenditure for each year and the average weekly quantity bought in each year. Moreover, the product information includes detailed characteristics. It shows for example the price that has been paid, if it has been bought under promotion,

but also simple product information such as the weight of a product. The breakfast cereal category offers also a categorisation into five subcategories: Instant Porridge, Porridge Oats and Ready-to-eat cereal (RTEC), Muesli and Granola.

In the current literature, there are limited studies that include promotion types due to the complexity of matching purchase and retailer plans and purchases. This given detail in this study makes it valuable and unique due to the rarity of obtaining this detailed data on promotion types. It is highly important to mention that the data used by Kantar Worldpanel, and therefore the information on the supermarket promotions is the prevalence of price promotions purchased and not the promotions offered in the supermarket. This study analyses only the promotional purchases recorded and not the available offers in a supermarket. Table 3.1 describes the product variables used in this study and the rationale behind them.

Table 3.1 Product variables and rationale behind datasets.

Product variables	**Rationale**
Product name	To include information about the name of the product
Product brand type	To identify branded (national) and private label (own brands) products
Product type	To summarise the products within a subcategory of breakfast cereals
Pack size	To identify the weight of the product
Promotion type	To determine if the product was purchased under price or volume promotion
Promotional discount	To identify the depth of the discount regardless of the promotion type
UK FSA NP score	To record the healthiness of each individual product

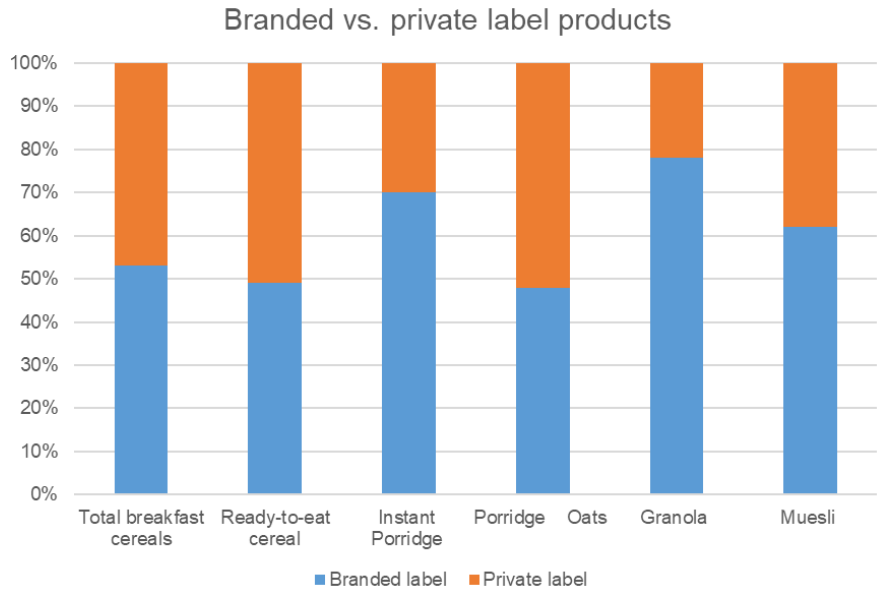
In the Kantar Worldpanel data, it is important to differentiate between product description and purchase data. The product dataset contains simply the products that have been purchased in 2015 as well as their product characteristics. The purchase data gives insights to the frequency of products purchased in 2015, under which promotion type they have been purchased, and also shop and household characteristics for each purchase linked to the breakfast cereal products in 2015. Overall, the data covers 1,122 breakfast cereal products that were purchased by 2,775 household across 2015 in Scotland.

For this study, the category breakfast cereals is defined to include ready-to-eat-cereals (RTEC), granola, muesli, instant porridge and porridge oats. Exclusions were breakfast and muesli bars, liquid breakfast products as well as yogurts. All products were recorded as often as they appear in the data from 2015 in relation to weight. This means that if Kellogg's Frosties is sold in 500g, 750g and 1kg packages, all of these were recorded as separate cereals due to different package sizes. The weight of the cereals was recorded in kilogram. The total number of products in the dataset is 603 without considering duplicates with different weights but the study uses 1,122 products as it is crucial to include products with different weights in a food category like breakfast cereals.

The following section describes three product characteristics in more detail. In the literature, brand label, healthiness and package size of the products have shown to be important when products are sold and purchased under promotion. Brand status and package size are described in this section, however the degree of healthiness across products will be illustrated later after the method to measure the healthiness has been explained. A product characteristic will focus on the national brands and private label of the products within the breakfast category and across five subcategories. The dataset of the 1,122 products that were sold in 2015 includes 103 different manufacturers (for example Kellogg's) with 603 different sub-brands (for example Kellogg's Frosties). These brands can be categorised into national branded products (53%) and private label products (47%). Out of 1,122 total breakfast cereal manufacturers, the predominant one is Kellogg's accounting for 13% of the products, followed by Tesco Food (9%), Sainsbury (8%), Weetabix (8%), Asda (7%), and Nestle (6%). Out of the top 15 manufacturer brands, seven are national brands and eight are own branded/ private labels, which the biggest manufacturer having the widest range of products is Kellogg's offering a range of products (140 out of the 1,122).

Figure 3.1 shows the distribution of purchased products of private and branded labels across the general category and the five subcategories of breakfast cereals. The aggregate category contains roughly equal proportions of branded products (53%) and private label products (47%). The dataset offers more information on the specific brands of the breakfast cereals. When looking at the biggest subcategory ready-to-eat cereals (RTEC), which makes up 71% of the whole breakfast cereal category, 51% are products with a private label and 49% branded. 16% of the products are instant porridge products and 70% of them are branded. Another balanced category is porridge oats with 48% branded and 52% private. Muesli and Granola only account for 2% of the sold products each but are dominated by branded products (62% and 78%).

Figure 3.1 Branded versus private label products across breakfast cereal subcategories in 2015.



Source: Own elaboration based on Kantar Worldpanel data

Package Size

Another key product characteristic considered in the literature is the size of the package. The most frequent product package sizes among the product information are 0.500 kg with 24% (275x), 0.375 kg 10% (109x) and 0.750 kg 9% (105x). Out of 1,122 products, 95 are *small* (0.001-0.100 kg), 429 are *medium* (0.101-0.475 kg), 493 *large* (0.500-0.999 kg) and 106 *extra-large* (1-3 kg). This information is illustrated in Figure 3.3. The role of the package size matters in the examination across promotion type purchases underlined with an example using a popular product. "Kellogg's Cornflakes" has been sold 1,731 times out of total 52,524 purchases in 2015, but in four different package sizes. 72% has been sold in 0.750kg package, 22% in 0.500kg, 5% in 1 kg packages and 1% in 0.375kg. The data gathered on the package size in terms of weight among the purchases of 2015 indicates that the weight plays an important role.

Figure 3.2 Package size across Kantar Worldpanel purchase dataset in per cent

Package size	**%**
500g	20
750g	17
375g	10
1000g	10
Small (1-300g)	7.4
Medium (301-700g)	60.6
Large (701-3000g)	32.0

Source: own elaboration based on Kantar Worldpanel data

Kantar Worldpanel Dataset: Shop information

In addition to the detailed product information given in the dataset, the information on the shop is also included. Specifically, the name of the retailer, total spent in the shop, shop address details, price details by product, and the promotion applied by the retailer are given for each purchase. The intention of this study is to investigate the nature of retail promotion types, instead of "name and shame" particular supermarket groups and therefore does not identify specific supermarket chains but rather refers to shop categories.

The supermarkets by retailer, which include 52 different retailers, have been transformed to categories. 2,775 households purchased 1,122 different products in 52 weeks resulting in 52,524 single purchases. The purchase dataset gives also information on the location of the purchased products. As reported in Table 3.2, the majority of 55.1% purchased the breakfast cereals in major supermarket chains in Scotland. 27% of all purchases were made in discounters followed by convenience formats (8%) and another 8% by online retailers. This means that 92% of the breakfast cereal purchases have been made in-store and 8% online in 2015.

Table 3.2 Purchases made across supermarket categories in Scotland.

Category	**Shop names**	**% in 2015**
Major supermarket brands (1)	ASDA, Asda Supermarket, Co-op, Morrison's, Marks and Spencer, M&S simply food, Sainsbury's, Tesco and Waitrose	55.10
Convenience formats of main retailers (2)	Tesco Metro and Tesco Express, Tesco Extra, Sainsbury's Local, other supermarkets, little Waitrose	8.35
Internet general (3)	Amazon, Internet	0.02
Internet retailer (4)	Ocado Internet, Waitrose Internet, Sainsbury internet, Tesco internet, Asda internet	7.70
Discount supermarkets (5)	Savers, Home Bargains, 99p stores, poundland, poundworld, B&M bargains, other bargain store, Iceland, Aldi, Costco, Lidl, Poundstretcher, Costcutter	26.71
Corner shops and local shops (6)	Delicatessen, Holland and Barrett, other health shop, Garage/Forecourt Shop, Other Grocer/Cornerstore, m local, market stalls, Bodycare/Grahams, B & Q / The Depot, Boots, Booths, Best One, Budgens, Cash and Carry, Costcutter, FarmFoods, Londis, Mace, Nisa Today, newsagents, off-licence shops, butchers, bakeries, fishmongers, One Stop, Premier Stores, market stalls and Spar	2.00
Other shops (7)	Newsagent, other chemist, other freezer, other	0.09

Kantar Worldpanel Dataset: Household information

This dataset is the result of a survey where representative households of Scotland are followed for a maximum of three years recording their food and drink purchases for consumption at home. In addition to the information about purchases, the dataset also includes household neighbourhood information such as rural/urban or local authority. Furthermore, socio-economic and demographic characteristics for all the households are included which are for example the household size, the number of children living in the household, but also the age and gender of the principal shopper.

Household and shop information are described briefly in this section and will be examined in detail later. The descriptive statistics will provide a brief overview of the household information. The first empirical chapter will describe the households in terms of aggregated information, but an intensive description of the household is done in the second empirical chapter.

The final sample consists of 2,775 households. Each purchase made by the household at each retailer was recorded as an individual record. Table 3.3 gives an overview of the household characteristics across the Kantar Worldpanel data of 2015 and it shows that the average age of the principal shopper is 48 and three quarters of the principal shoppers in this dataset are female. Further insights given from the household description are the information about the household living with or without children – 64% of the household do not have a child living in the household, 18% one child and 14% have 2 children. Overall, the Scottish Index of Multiple Deprivation (SIMD), which is an official measure of relative deprivation in Scotland, shows that 19% of the households in the Kantar dataset have being classified as most deprived and 16% in least deprived households of Scotland. The SIMD will be elaborated further in Section 3.2.2. Moreover, the annual income it gives an insight to the income groups and its distribution. The mean income is £29,699 and the three biggest annual mean income groups are £15,000 (25%), followed by £25,000 (24%) and £35,000 (17%).

Table 3.3 Household information across Kantar Worldpanel household dataset.

Variables	N	Mean (SD)	Min	Max
Age				
Age of the principal shopper	2775	47.95 (14.15)	18	89
Sex				
(1 = Female; 2 = Male)	2775	1.25 (0.43)	1	2
Female principal shopper		75%		
Male principal shopper		25%		
Children				
Total	2775	0.59 (0.91)	0	6
0 children	1780	64.14%		
1 child	495	17.84%		
2 children	377	13.59%		
3 children	105	3.78%		
4 children	14	0.50%		
5 children	3	0.11%		
6 children	1	0.04%		
Scottish Index of Multiple Deprivation (SIMD)				
SIMD	**2775**	**2.93 (1.36)**	**1**	**5**
Quintile 1 (most deprived)	539	19.42%		
Quintile 2	607	21.87%		
Quintile 3	586	21.12%		
Quintile 4	582	20.97%		
Quintile 5 (least deprived)	461	16.61%		
Average income per household				
Total	**2775**	**29,699 (16,986)**	**5,000**	**70,000**
1 £ 5,000 pa	245	8.83%		
2 £15,000 pa	696	25.08%		
3 £25,000 pa	667	24.04%		
4 £35,000 pa	469	16.90%		
5 £45,000 pa	312	11.24%		
6 £55,000 pa	198	7.14%		
7 £65,000 pa	86	3.10%		
8 £70,000 pa	102	3.68%		

3.2.2. Scotland: Scottish Index of Multiple Deprivation

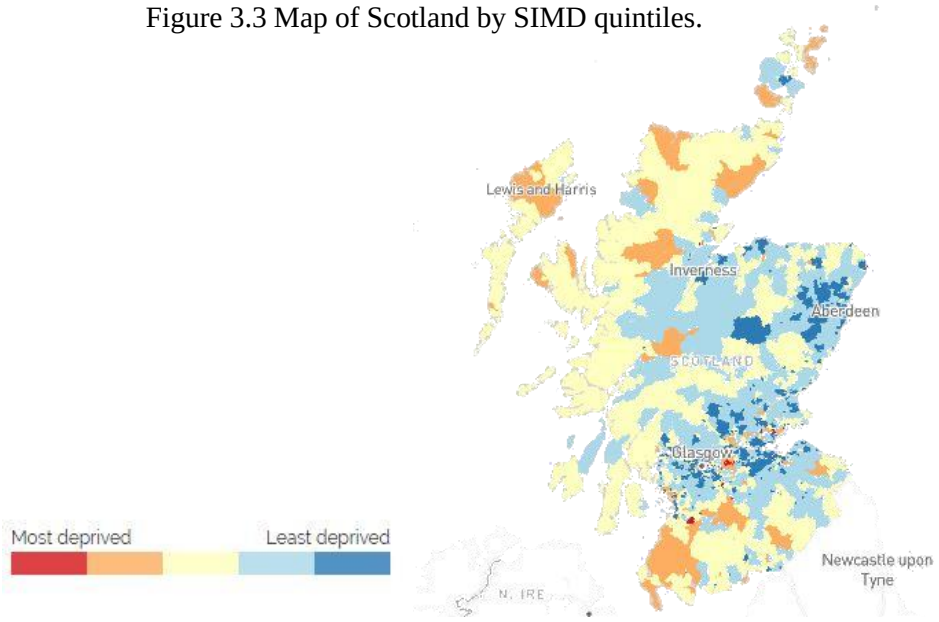
Household level scanner data offers socio-economic attributes in order to be able to investigate the household characteristics that influence the consumer decisions. The Kantar Worldpanel dataset has been merged with the Scottish Index of Multiple Deprivation to enrich the household information further with specific Scottish information.

A key topic in this study is the socio-economic background of the consumers when purchasing goods in the supermarkets. Among previous studies, there is no consistent characterisation of socio-

economic groups. Many authors base their definition on different characteristics such as focussing only on the profession and income (Turrell et al. 2002; Hulshof et al. 2003; Pechey and Monsivais 2015) while some take up to 7 different characteristics into account (Ball et al. 2015; Whybrow et al. 2017). One of the possible measurements to investigate the socio-economic characteristics of the household is the level of deprivation in Scotland. This research uses the "Scottish Index of Multiple Deprivation" (SIMD) which is the Scottish Government's official tool for identifying those geographic areas in Scotland suffering from socio-economic deprivation and combines several different aspects of deprivation into a single index (Revoredo-Giha et al. 2018; Campbell et al. 2020). The seven domains being considered are income, employment, health, education, skills and training, housing, geographical access and crime. The weightings used in the SIMD 2012, expressed as a percentage of the overall weight are: current income (28%), employment (28%), health (14%), education (14%), geographic access (9%), crime (5%), housing (2%). It is clear from the index construction that deprivation denoted by the SIMD is addressed by a wide range of problems and deprivation is not only reflected in the sense of poverty. Therefore, the SIMD's virtue of being multidimensional is a crucial advantage.

An overview of the SIMD values for different Scottish geographical regions is given in Figure 3.3. It divides Scotland into 6,505 small areas, called data zones, each containing around 350 households. The index provides a relative ranking for each data zone, from 1 (most deprived) to 6,505 (least deprived). The data zones can vary hugely in area, because they are population based (on average 800 people in each data zone) therefore in towns and cities where people live close together, data zones can contain only a few streets, while in rural areas that are sparsely populated, they can cover many square miles. Based on the rank order of these data zones, the establishment of quintiles from 1 to 5 are an appropriate measure of the deprivation status. Quintile 1 contains the most deprived areas within Scotland and the Quintile 5 contains the least deprived areas. It is important to stress the fact that SIMD is not equal to income as the latter is only one part of different components making up the SIMD.

Figure 3.3 Map of Scotland by SIMD quintiles.



There has recently been interest in the socio-economic background of consumers. The Food Standards Scotland (2016) report analysed purchasing patterns in relation to the Scottish Index of Multiple Deprivation (SIMD). The Scottish diet is poor across all socio-economic groups but the most deprived suffer from the poorest diet among all. Regarding the consumption behaviour across different socio-economic groups, it is found that the most deprived areas buy most of their calories in the form of confectionery, biscuits, regular soft drinks and bread, whereas the least deprived households obtain more from cakes and pastries, plain starchy carbohydrates, oil-rich fish and fruit and vegetables. However, the SIMD does not have an effect, or only a little, on the energy purchased on promotion and only a little variation was found in the nutrients purchased by quintile of SIMD (Campbell et al. 2020). Scottish Government examined retail purchases (2018) and found when looking at the Scottish purchases across income, that the highest income groups purchased 39% of their purchases under promotion and the lowest groups spend a lower proportion (33%) on promotional purchases. All in all, the section shows the interest of many studies and the attempt of the Scottish government to change the Scottish diet to a better one because the obesity crisis continues without significant changes in the past 17 years and the government is working on more drastic changes to improve the population's health.

3.2.3. Healthiness of food products using UK FSA

Defining the healthiness of a diet depends on several influences such as culture, education or family background and differs among worldwide eating habits and personal opinion what "healthy" means. The challenge to find common measures across products and countries that allow comparable results. One way to think about healthy diets is to categorise food products into healthy and less healthy components and on the basis of which individuals should maintain an adequate consumption of healthy

food components such as fruits and vegetables and a moderate (or very limited) consumption of less healthy ones for instance saturated fat, sugar, sodium. To categorise food products, frameworks to assess the healthiness of products have been implemented based on particular dietary recommendations and national guidelines. In order to have a common measurement a nutrient profiling model can be applied which needs to be easy and understandable for all consumers across culture, age and education. A nutrient profiling model uses a fixed calculation giving a clear structure and includes balanced information about healthy food consumption and nutrition-rich diet. This review starts with an overview of the principles behind the method of nutrient profiling, followed by the description of different nutrient profiling models across countries and finishes with the UK FSA nutrient profiling model which will be used in this study.

A general nutrient profiling model consists of different categories including several options. They are dealing with the nutritional components, the application on products, as well as the base measure and the result measurement system, which is often a threshold or a scoring system. A nutrient profiling model differs in the use of different components. Components could be part of a product such as water or energy but can also describe for instance the amount of fruit and vegetables within a product, however for simplicity reasons all parts within a nutrient profiling will be called nutrients. The EU allowed 31 nutrients in the nutrition labelling list and it has been decided that energy, protein, fat and carbohydrate have to be presented due to their key importance in dietary guidelines. Most of the models subtract "good" nutrients from the "bad" ones, and the result gives implications for the healthiness of a product (Scarborough et al. 2007b). Overall, the policy implications are important in this research and the literature has mentioned this method can implicate a change in consumer diets. However, the need for understanding nutritional information on products as a consumer is important. Implementing a food scoring system would lead to consumers choosing healthier products and improve the nutritional content of their products purchased by 22% on average.

Nutrient profiling frameworks

The section introduces different characteristics of existing nutrient profiling models and show internationally applied ones to justify the approach of defining the healthiness of products in this study. In order to differentiate "healthy" and "unhealthy" foods, it is common in the literature to use nutrient profile models (Azais-Braesco et al. 2006; Garsetti et al. 2007; Scarborough et al. 2007a; Scarborough et al. 2007b; Lobstein and Davies 2009; Scarborough et al. 2010; Scarborough et al. 2013; Julia et al. 2015).

Nutrient profiling refers to a way of categorising foods based on their nutritional composition. The term was first coined by the European Commission in 2003. The three main differentiations across nutrient profiling models will be explained in the following section (1) food-category-specific or across-the-board criteria, (2) base measure, (3) threshold or scoring system.

Nutrient profiling models are either constructed as food-category-specific or as across-the-board, meaning that some models treat all products equally (across-the-board) while others consider different categories of various products separately (category specific). Across-the-board criteria allow to use one nutritional composition formula for all available products and is not differentiated between categories, whereas category-specific does differentiate either in the formula or in the thresholds (Scarborough et al. 2007b). Another difference is the use of the base measure. 100g or the serving size or 100kJ can be different ways to set the amount of nutrients as a base. "Per 100g" is the most common base for nutrient profiling and it is also the base in food composition tables. "Per 100 kJ" is a measure of kilojoules showing how much energy a product includes depends on the amount of carbohydrate, protein and fat the food contains. This measure gives an indication on how much to eat when staying with the recommended amount of energy requirements e.g. an active and healthy male person (18-50 years old) is recommended to have 2900 kcal or 12200 kJ daily to keep the weight. Another possible measure of a base for calculating a nutrient profiling model is the serving size. "Per serving" takes into account the way people consume and the amount of the product itself and varies a lot across foods and categories (Scarborough et al. 2007a).

A third component is the presentation of the results differentiating between threshold or scoring systems. The design of the presentation of the results can vary across two options, which are categorical or continuous. Categorical models divide the products/foods into two or more categories and are also called threshold models because they use the nutrient content of a product to define it as higher as or lower than a specific threshold. These categorical models are the most common type of nutrient profile model. However, continuous models provide a ranking of products and are therefore more complex than one threshold. Continuous models are often scoring systems, because they are used to calculate a score for each product and this score can then be ranked. Moreover, another option is the combination of both ways. Continuous models can be converted into categorical models through setting score threshold criteria. For example, a product can be defined as 'unhealthy' if it scores a certain number of points or more (Scarborough et al. 2007b).

There are various types of nutrient profiling models across different country models such as the United States, Australia and New Zealand, France, the Netherlands or United Kingdom (Garsetti et al. 2007; Quinio et al. 2007; Trichterborn et al. 2011; Julia et al. 2015) and some go beyond these principles of nutrient profiling models. They mostly differ because countries implement different national nutritional recommendations and dietary guidelines. According to Azais-Braesco et al. (2006) the different nutrient profiling systems are powerful tools in order to be able to translate nutritional information. The implementation of a nutrient profiling model is useful to help consumers to make healthier food choices among their supermarket purchases. Table 3.4 gives an overview over common nutrient profiling models worldwide and their main characteristics and principles.

Table 3.4 Parameters of common nutrient profiling models.

Name	**Contains**	**(1)**	**(2)**	**(3)**
"FSA Scoring System" by Food Standards Agency (UK)	(-) Total Sugar, Saturated Fatty Acids, Sodium, Energy (+) Protein, Fibre, Fruit and Veg and Nuts	Across the board	100g	Scoring scale
"USA Health Claim" scheme by Food & Drug Administration (US)	(-) Fat, Saturated Fatty Acids, Cholesterol, Sodium (+) Nut among VitC, VitA, Protein, Fibre, Calcium, Iron	Across the board	Serving size	Threshold
"Tripartite Classification Model" by Netherlands Nutrition Center (NL)	(-) Total Sugar, Saturated Fatty Acids, Energy (+) Iron, VitC, Folate, Omega -3 fatty acids	Category wise	100g	Threshold
"Keyhole" by National Food Administration (Sweden)	(-) Fat, Added sugar (+) Dietary Fibre, % whole cereal (According to Food Cat)	Category wise	100g /100 kcal	Threshold
"ANFZA Scheme" by New Zealand Food Authority (AUS/ NZ)	(-) Fat, Saturated Fatty Acids, Sodium, (+) 1 Nutrient among all Vitamins, Minerals, Fibre	Across the board	Serving Size	Threshold
Nutri-Score by French Ministry of Health (FR)	(-) Energy, total sugar, saturated fat, sodium, (+) Fruit, vegetables, nuts, fibre, protein	Across the board	Per 100 g or 100 mL	5-point colour grade scale

In the academic literature several approaches have been found. Whitton et al. (2011) use daily intakes of macronutrients such as Energy (kcal), Fat or Carbohydrates and also daily intakes of micronutrients such as vitamins in order to define healthy and unhealthy. Appelhans et al. (2012) define healthy and unhealthy by using ten nutritional variables: energy density (kcal/g); protein, carbohydrate, total fat, saturated fat, *trans* fat, and total dietary fibre (g/1000 kcal); sodium (mg/1000 kcal); and fruit and vegetables (cups/ 1000 kcal). Monsivais et al. (2010) measure nutritional quality using two different nutrient profiling scores. One is the **"**Naturally Nutrient Rich score" based on 14 nutrients protein, fibre, monounsaturated fatty acids and a variety of vitamins and minerals and the other one "Nutrient Rich Food Index" based on 9 nutrients to encourage protein, fibre, vitamins A, C, and E, calcium, iron, potassium and magnesium, and three nutrients to limit: saturated fat, added sugar, and sodium. Garsetti

et al. (2007) compare five main schemes which are ‘‘A Little, A Lot’’ scheme (UK, Ministry of Agriculture), ‘‘USA Health Claims’ ’scheme (USA, Food & Drug Administration—FDA), Tripartite Classification Model (The Netherlands, Netherlands Nutrition Center), ‘‘FSA Scoring System for Children’’ (UK, Food Standard Agency—FSA), ‘‘GRFMC’’ scheme (Guidelines for Responsible Food Marketing to Children, USA, Center for Science in the Public Interest). Quinio et al. (2007) agree with the main schemes and compare the UK FSA WXY model, the Dutch Tripartite model and the US FDA model whereas others compare other models such as the Swedish Keyhole, Choices Programme, Smart Choices program, FSA/OFCOM, LIM by Trichterborn et al. (2011). To sum up, nutrition profiling, including their role for front-of-pack labelling, is influenced by cultural, economic, political, and social factors. Therefore, approaches to develop and implement them as well as education campaigns have to be context-specific to identify with the country’s demographics, including factors such as health, as well as its food system (El-Abbadi et al. 2020).

Food Standards Agency’s 2004/05 Nutrient Profiling Model (UK FSA)

The Food Standards Agency (FSA) in the UK has developed a model to define healthier and less healthy foods for promotions on children’s food and regulating nutrition and health claims made on food (Department of Health Nutrient Profiling Technical Guidance 2011). The model uses a simple scoring system where points are allocated on the basis of the nutrient content of 100g of a food or drink. The nutrient profile model developed by the FSA will be used in this study and is calculated on the basis of the nutritional composition in 100g of the product. Points are awarded for ‘A’ nutrients (energy, saturated fat, total sugar and sodium), and for ‘C’ nutrients (fruit, vegetables and nut content, fibre and protein). The score for ‘C’ nutrients is then subtracted from the score for ‘A’ nutrients to give the final nutrient profile score. A food is classified as “less healthy” when it scores 4 points or more and “healthier” when it scores 0 points or less. A drink is “less healthy” when it scores 1 point or more and “healthy” when it scores 0 or less. Scores for foods and beverages were based on a scale from −15 (most healthy) to +40 (less healthy). -15 is the healthiest score a product can reach due to the fact that if a product has no bad nutrients and the highest score of the good nutrients, the good ‘C’ nutrients (3 nutrients having the maximum of 5 points each) will be subtracted from zero ‘A’ nutrients. 40 is the unhealthiest score possible which can result from having all 4 bad ‘A’ nutrients reaching the highest score of 10 and scoring zero good nutrients, which will not subtract any points in the final calculation. The following tables 3.5 and 3.6 indicate the points scored, depending on the content of each nutrient in 100g of the food.

Table 3.5 A- Points scored in the UK FSA Nutrient Profiling model.

Work out total 'A' points (A maximum of ten points can be awarded for each nutrient)											
Total 'A' points = (points for energy) + (points for saturated fat) + (points for sugars) + (points for sodium)											
Points	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Energy (kJ)	≤ 335	>335	>670	>1005	>1340	>1675	>2010	>2345	>2680	>3015	>3350
Sat Fat (g)	≤ 1	>1	>2	>3	>4	>5	>6	>7	>8	>9	>10
Total Sugar (g)	≤ 4.5	>4.5	>9	>13.5	>18	>22.5	>27	>31	>36	>40	>45
Sodium (mg)	≤ 90	>90	>180	>270	>360	>450	>540	>630	>720	>810	>900

Table 3.6 C- Points scored in the UK FSA Nutrient Profiling model.

Work out total 'C' points (A maximum of five points can be awarded for each nutrient)						
Total 'C' points = (points for fruit, veg & nut content) + (points for fibre [either NSP or AOAC]) + (points for protein)						
Points	**0**	**1**	**2**	**3**	**4**	**5**
Protein (g)	≤ 1.6	>1.6	>3.2	>4.8	>6.4	>8.0
NSP Fibre (g)	≤ 0.7	>0.7	>1.4	>2.1	>2.8	>3.5
OR AOAC Fibre (g)	≤ 0.9	>0.9	>1.9	>2.8	>3.7	>4.7
Fruit, Veg & Nuts (%)	≤ 40	>40	>60	-	-	>80

If a food or drink scores less than 11 'A' points then the overall score is calculated as follows: Overall score = (total 'A' points) minus (total 'C' points). If a food or drink scores 11 or more 'A' points but scores 5 points for fruit, vegetables and nuts then the overall score is calculated as follows: Overall score = (total 'A' points) minus (total 'C' points). If a food scores 11 or more 'A' points but also scores less than 5 points for fruit, veg and nuts then the overall score is calculated as follows: Overall score = (total 'A' points) minus (fibre points + fruit, veg and nuts points only) [i.e. no points for protein]. A food is classified as "less healthy" where it scores 4 points or more. A drink is classified as "less healthy" where it scores 1 point or more.

Discussing the UK FSA model in detail, both advantages and disadvantages have been evaluated in the literature. Many authors are in favour of this UK FSA method of nutrient profiling. The literature compares various nutrient profiling models and the advantages of using this UK FSA nutrient profiling model are advocated in the studies by Azais-Braesco et al. 2006; Garsetti et al. 2007; Scarborough et al. 2007a; Scarborough et al. 2007b; Lobstein and Davies 2009; Scarborough et al. 2010; Scarborough et al. 2013; Julia et al. 2015; Scarborough et al. 2015. Several reviews and validation

processes have been done on this specific model. Lobstein and Davies (2009) mention that the Food Standards Agency's Nutrient profiling model was overseen by several experts in the field of diet such as independent nutritionists and dieticians, representatives from the food industry and consumers as well as members of the Scientific Advisory Committee on Nutrition (SACN). Moreover, Scarborough et al. (2007a) compare eight different nutrient profiling models to the views of 700 nutritionist and dietarians in the UK and the model developed by the UK Food Standards Agency was the highest ranked in accordance. Garsetti et al. (2007) argue also that the FSA scheme is the only one that has been validated by experts. They compare 23 different schemes and most of them are across the board as well as using 100 g as a reference amount, which supports this FSA model as it is similar. Another paper by Scarborough et al. (2007b) emphasises that using this specific model from the Food Standards Agency would be a successful solution for general nutrient profiling and not just limiting it for health claims for children. Further, Azais-Braesco et al. (2006) compare and analyse the structure and efficiency of existing nutrient profiling systems. In their study the FSA scoring system has the most consistent approach compared to others. Besides, Garsetti et al. (2007) by comparing several nutrient profiling models, conclude that the FSA has been the most multifaceted one owing to the complexity for the information needed to calculate the food composition and the use of the scores. Moreover, a continuous model such as the UK FSA provides a ranking and is more complex than a categorical one which only gives information about the nutrient content being higher or lower than the threshold (Scarborough et al. 2007b). All arguments are supporting and encouraging the current model to be applied in this study because it will provide a detailed ranking scale to measure the healthiness of each individual product.

The validation of the model has been approved through the application across several countries. Further countries use the UK FSA model for example in France (Julia et al. 2015). They mention that France added a five-colour nutrition label called "Nutri-Score" on the front of pack of food products and such an approach is based on the scoring of nutritional content using the Food Standards Agency nutrient profiling system. Julia and Herberg (2017) find that the scientific evidence suggests that the British Food standards Agency nutrient profiling model underlying the Nutri-Score label can adequately characterise the nutritional quality of foods and the Nutri-Score label has been implemented in several countries in 2020 also across the industry such as Nestle implemented the label across eight countries. Also, Australia uses the UK FSA model as a basis according to Scarborough et al. (2010) and mention that the nutrient profiling model is one of the best validated nutrient profiling models and the most appropriate for its applications especially when used for regulating the advertising of foods to children in the UK and, in an adapted form, for regulating health claims for foods in Australia."

However, previous studies have examined the disadvantages of the UK FSA nutrient profiling model. Drewnowski (2007), by comparing the US NNR score and the UK FSA model, criticises that the FSA model penalises energy-dense foods such as grains because they are dry and full of the component "energy". Furthermore, fruits and vegetables are not differentiated within their category. Also, the literature discusses the kind of reference amount which should be used for the nutrient

profiling models and the debate is on whether 100g or 100 kcal or per serving is the most appropriate method. The former is supported by Rayner et al. (2009) because the nutritional quality of the food per 100g is generally applicable, and it does not matter how much of the food will be eaten as a recommended serving size. Although the method is well accepted in the literature, Drewnowski and Fulgoni (2008) add to the discussion that the 100g scheme penalises all kinds of foods that are often unhealthy foods as they are usually consumed in smaller amounts than 100g. Another criticism is that the FSA system mainly focusses on a specific age group (6 to 11 years old) as it was set up to regulate the allowance for advertisement for specific products (Azais-Braesco et al. 2006). However, the literature has stated that the FSA model can be used for general nutrient profiling and not just for health claims for children (Scarborough et al. 2007b). To sum up the disadvantages of the FSA nutrient profiling model, it penalises energy-dense food, which can be healthy e.g. grains, and also through using the 100g base as a measure, it also penalises unhealthy foods because they might be eaten in smaller portions (referring to the serving size). Moreover, it has been criticised that the model does not differentiate between food categories especially for fruit and vegetables (Azais-Braesco et al. 2006; Drewnowski and Fulgoni 2008).

Nevertheless, this research will use the UK FSA model which has been validated by many experts across different countries and has been ranked one of the best nutrient profiling models. Due to the complexity as well as the details needed to calculate the score and the scoring system linked to a threshold, products can be ranked and categorised as healthy or less healthy. Besides, various studies similar to this thesis have actually worked with this nutrient profiling model to define healthy and less healthy: Nakamura et al. (2015) as well as Pechey & Monsivais (2015) but also recent UK (UK Government 2020) and Scottish Government reports (Campbell et al. 2020) apply this Food Standards Agency's 2004/05 Nutrient Profiling Model to calculate healthiness and set up campaigns based on this method. Further, it has been used as a tool to define what products can and cannot be advertised during children's programming. Work on the model is led by Public Health England (PHE), and involves (for example on the Nutrient Profiling Expert Group) Department of Health and Social Care (DHSC), Department for Digital, Culture, Media and Sport (DCMS), Department for Environment, Food and Rural Affairs (DEFRA), and the devolved administrations.

Application of the UK FSA Nutrient Profiling Score to the Kantar Worldpanel dataset

Based on the UK FSA Nutrient Profiling the following breakfast cereals are ranked the healthiest to the least healthy in the Kantar Worldpanel dataset. The FSA score can range from -15 (the healthiest) to +40 (the least healthy score).

The degree of healthiness plays a crucial role in this study and the following graph underlines the varieties in healthiness of the products in the study. Out of 1,122 products, the UK FSA score ranges from -13 to plus 6 across all breakfast cereal products. Values from -6 up to 3 are considered *healthy* and from 4 to 13 are indicative of the *less healthy* products. The most frequent UK FSA score is -1

which is considered healthy. Of the total breakfast cereals, 81% are considered healthy. The least healthy proportion subcategory is the Granola (70%) and the ready-to-eat cereal (76%). In line with other studies that used the UK FSA nutrient profiling score on breakfast cereals, the proportion of healthy and unhealthy lies in a similar range. Devi et al. (2014) have 74% of their products classified as healthy and 26% less healthy in New Zealand as well as Potvin Kent et al (2017) with 70% healthy and 30 % less healthy in Canada. This study has 81% healthy cereals, which can be explained by the high amount of porridge variations in the United Kingdom compared to for example New Zealand and Canada. Table 3.7. gives examples of products across all subcategories in the breakfast cereal category with their individual product score calculated and the threshold ("healthy" or "less healthy") applied.

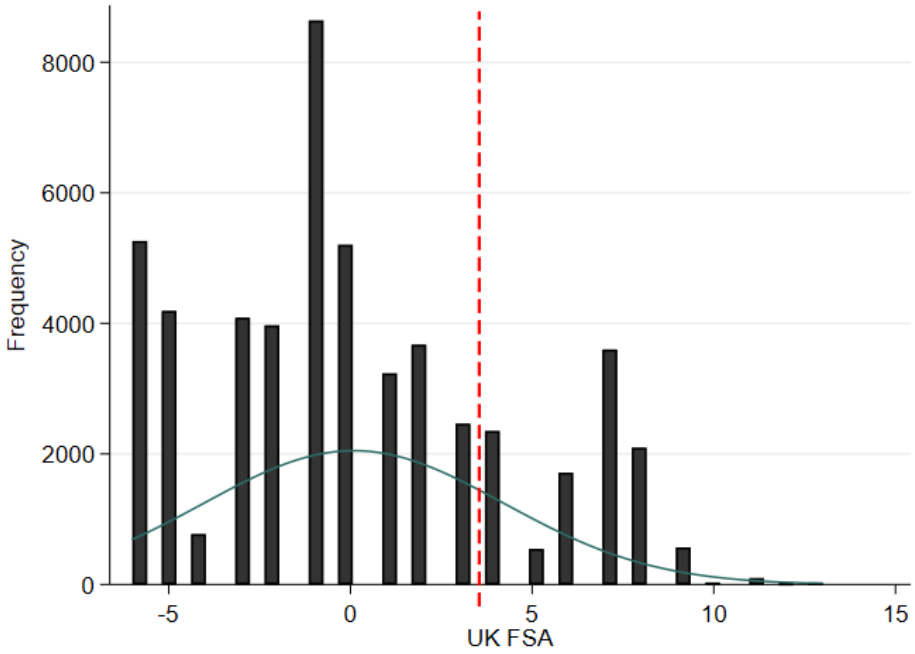
Table 3.7 Breakfast cereals ranked by UK FSA Nutrient Profiling.

UK FSA Classification	**FSA Score**	**Product example**
Healthiest	-8	Morrisons Bran Cereal
Healthy	-6	Hot Oat Instant Porridge (Sainsbury's) Oat Porridge (M+S/ Tesco) Whole-Wheat Biscuit Weetabix
Healthy	-1	Kellogg's Cornflakes Quaker Oat So Simple Golden Syrup Jordans Muesli Nuts and Seed
Threshold	4 or more	= less healthy
Less healthy	8	Nestle Curiously Cinnamon Frosted Kellogg's Frosties Nestle Chocolate Crunch
Less healthy	11	Quaker Harvest Crunch Raisin Kellogg's Crunchy Nut Granola Chocolate and Nut Mornflakes Strawberry
Least healthy	19	Klik Choco Cornflakes

Source: own elaboration based on Kantar Worldpanel data

The Figure 3.4 shows the distribution of the UK FSA Score across the purchases made that are used in the analysis. Out of all purchases, most products had a score of -1, followed by a score of -6 and a score of 0, all three considered healthy products. The dotted red line separates healthy and less healthy purchases (4 or more points are considered less healthy).

Figure 3.4 Frequency of UK FSA score across purchased products.



Source: own elaboration based on Kantar Worldpanel data from 2015

3.3. Construction of the database

The final database has been created from different data sources and has been merged into one database in order to be analysed by different levels in each research question. This section describes the preparation that has been done before the analysis to build up the final dataset.

Figure 3.5 Composition of merged database.

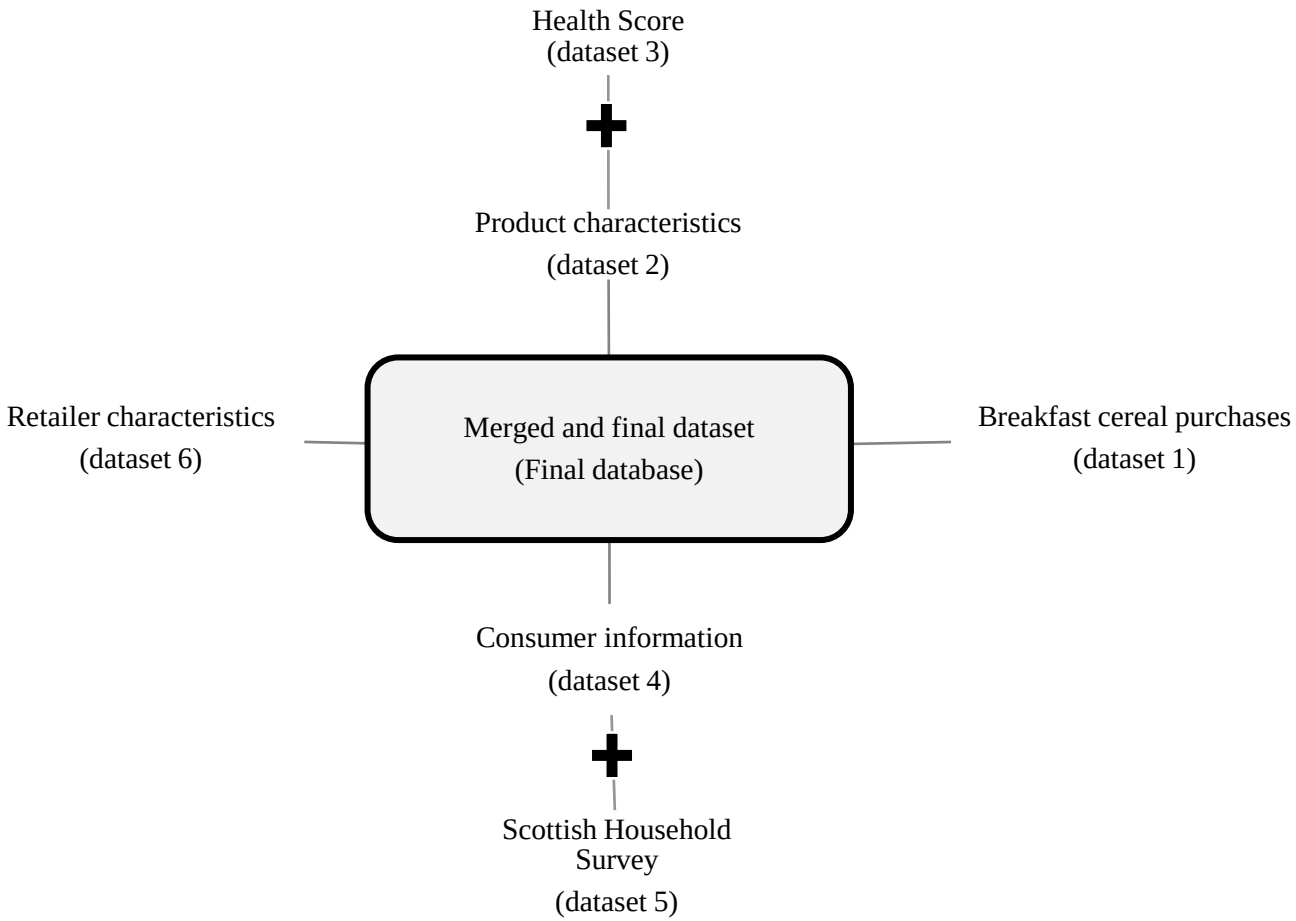


Figure 3.5 illustrates the merging of datasets containing purchase information, household characteristics, retailer information, and product information including the health score for each product gives an overview of the process of merging the datasets to create a final dataset used in the analysis. Overall, the database includes 3 main sources of data: (i) Kantar Worldpanel data (including product, household and shop information) but also (ii) UK FSA Heath Score (additional information for products) and (iii) SIMD (additional information for households)

Dataset 1: Prices and promotions

includes all 52,524 purchases made in the breakfast cereal category in the year of 2015 by the Kantar Worldpanel market research. The purchase data gives insights to the frequency of products purchased in 2015 and under which promotion type they have been purchased across the year.

Dataset 2: Product characteristics

includes the products that have been purchased in 2015 and their product information. These 1,122 products are included in the purchase dataset 1, however this dataset gives more detail about the products such as the weight of the package, the manufacturer and the brand of the label. For this study, the category ‘breakfast cereals’ is defined to include ready-to-eat-cereals (RTEC), granola, muesli,

instant porridge and porridge oats. Exclusions were breakfast and muesli bars, liquid breakfast products as well as yogurt products. All products were recorded as often as they appear in the data from 2015 in relation to weight meaning that products with different package sizes are tracked separately. This means that if *Kellogg's Frosties* is sold in 500g, 750g and 1kg packages, all of these were recorded as separate cereals. The weight of the cereals was recorded in kg. The unique number of products, which removes duplicates with different weights, is 603 however, including different weights there are 1,122 different products.

Dataset 3: Healthiness of products

includes the UK FSA nutrient profiling score for each product in dataset 2. The nutrient profile model developed by the Food Standards Agency (FSA) is used in this study and is calculated on the basis of the nutritional composition in 100g of the product. A food is classified as "less healthy" when it scores 4 points or more and "healthier" when it scores 0 points or less. Scores for foods and beverages were based on a scale from −15 (most healthy) to +40 (least healthy). In order to classify breakfast cereals in healthy and unhealthy categories, which were purchased in the Kantar dataset, nutritional information was necessary and not given in the Kantar World panel data. For this reason, nutritional information from Mintel dataset was used and merged. The majority of them were matched with the Mintel data through the same Product ID. The nutritional information for the remaining breakfast cereal products has been gathered by collecting data manually from packaging, online or in-store to be able to calculate the nutrient profiling score.

Dataset 4: Consumer information

Household information is included in the **dataset 4** for 2,775 households. Each purchase made by the household at each retailer was recorded as an individual record. Additional information on the household by characteristics of the households such as demographics and socio-economic background is given in this data.

Dataset 5: Deprivation Data

is the Scottish Household Survey that has been used with propensity score matching to be able to reduce the amount of missing values from the panel data. In order to eliminate missing values that have been present in the Kantar panel data, and to avoid dropping a household from the sample because of for example one missing income figure or a missing Scottish Index for Multiple Deprivation (SIMD) quintile in the Kantar data, the Scottish Household Survey was used to match similar families. The survey was retrieved from the Scottish Government's website. The Scottish Household Survey (SHS) is an official survey by the Scottish Government, based on a sample of the general population of the Scottish residents. The large-scale and continuous survey started in 1999 and gives an insight into the composition and behaviour of the Scottish population. The information is given in face-to-face interviews and gives evidence on characteristics and attitudes of the private households. Moreover, it informs about physical conditions of the homes and details on age, income, gender, rurality, ethnicity and deprivation level.

Propensity Score Matching

In this study, the cross-section data for the year 2015 used the Propensity Score Matching to decrease the amount of missing values of the household characteristic on two variables: the income and the deprivation level. The information given in the Scottish Household Survey 2015 was matched with the household information in the Kantar dataset to match the missing information with that of similar households. The Kantar dataset is the main dataset and a second one, which is the Scottish Household Survey, have comparable observed characteristics e.g. the sex and age of the principal shopper and the amount of adults and children living in the household. Propensity scores were suggested by Rosenbaum and Rubin (1983) and are used as a method to control for observed variables and matching them by propensity scores and not the regressors. The score is a predicted probability of receiving treatment based on their characteristics. The control and treated population have comparable characteristics based on the propensity score. The specific method used in this study is the one-to-one matching with replacement also called "Caliper matching" and estimates the average treatment effect and the average treatment effect on the treated by the nearest neighbour matching, which is the most common and simplest matching algorithm (Disegna et al. 2018). Nearest neighbour matching is a method that uses an average of the outcomes of similar subjects, in this study the income based on similar characteristics age, number of adults, number of children, sex, social class, and income in the SHS data, to impute the missing outcome – the variable "income"- in the Kantar data. The "nearest neighbour" is calculated by using a weighted function of the independent variables for each observation. The treatment effect is the average of the distances between the observed and imputed outcomes and can be used on variables such as continuous, binary, fractional, or nonnegative (Disegna et al. 2018).

Dataset 6: Retailer characteristics

includes shop information on the retailer where the products have been purchased and gives information on the name of the retailer and store categories.

The datasets 1 to 6 have been merged to a database that included all the purchase information including product, shop and consumer characteristics for each purchase. All datasets create the database that will be analysed differently in each research question for instance collapsing the database by products and analysing it with a fractional multinomial logit or collapsing it by households analysing it through a quantile regression. Table 3.8 illustrates merging of datasets linked to the number of observations.

Table 3.8 Overview of data used in the study to create database.

Dataset	Description	Observations
1	Purchases made in the breakfast cereal category in 2015	52,524
2	Products sold in 2015 + product characteristics	1,122
3	Added UK FSA Score for all products sold in 2015 included in dataset 2	1,122
4	Households and their characteristics that purchased products in 2015	2,775
5	Scottish Household Survey information matched with dataset 4	
6	Retailer and shop information used in 2015	57
Merge	A merged dataset was created by merging the information from dataset 1 to 6 into one.	
Final	**Dataset used in this analysis collapsed the merged dataset by products.**	

Depending on the research question the final dataset is organised by two dimensions namely collapsing over (a) products and (b) households, giving 2 datasets that are assembled to address each RQ1 and RQ2. These two dimensions represent the products and households reflecting the supply-side and demand-side orientation of the research questions. Due to the number of variables in this study, they have been categorised across three groups of parameters: product characteristics, household characteristics and shop information. Throughout the thesis, a colour coding scheme (Table 3.9) will be applied to identify different subsets of information found in the analysis such as the household information, product and retailer characteristics. To give an easier overview in the vast number of variables the following colours will be applied throughout the thesis and therefore differentiating each subset has its own type of branding to simplify information at one glance and help the reader to understand what type of data they look at across tables and figures in the data and result sections of the thesis.

Table 3.9 Colour coding scheme of subsets of information in the thesis.

Blue	Retail promotion type information
Orange	Socio-economic household characteristics
Yellow	Product characteristics
Green	Shop information

3.4. Nature of the data in the analysis

This thesis analyses a secondary data source, the Kantar Worldpanel survey, which includes barcode-specific supermarket purchases by around 2,800 representative households across Scotland and contains weekly information at the household level about prices paid, whether it was purchased under promotion, the quantities purchased, as well as socio-economic and demographic characteristics of the households.

This study combines information of large datasets to address questions relating to the role of supermarket promotions on improving consumer diets and analyses purchases among different socio-economic characteristics of consumers in Scotland. In this study, the Kantar food purchase data are combined with socio-economic characteristics of households using the Scottish Index of Multiple Deprivation (SIMD) and the UK Food Standards Agency Nutrient Profiling scheme to assess the impact of promotions on purchases of healthy and unhealthy food evaluated at the barcode-specific level. The analysis reported in this thesis focuses on the category of breakfast cereal, owing to the essential nature of category in consumer spending and the wide variation in healthiness of breakfast products. In the United Kingdom, consumers can choose from over 2,000 brands across porridge oats, ready to eat cereal, instant porridge, granola or muesli, which are all recorded in the Kantar Worldpanel data. Moreover, the information is divided into five subcategories Instant Porridge, Porridge Oats and Ready-to-eat cereal (RTEC), Muesli and Granola, which is then further categorised into healthy and less healthy based on the UK FSA Nutrient Profiling Score. Exclusions were breakfast and muesli bars, liquid breakfast products as well as yogurt products.

Two types are considered, price (e.g., 10% off) and volume (e.g., buy-one-get-one free) type promotions. In the current literature, there is only limited amount of studies that include promotion types due to the complexity of matching purchase and retailer plans and purchases. This given detail in this study makes it valuable and unique due to the rarity of obtaining this detailed data on promotion types. It is important to mention that the data used by Kantar Worldpanel, and therefore the information on the supermarket promotions is the prevalence of price promotions purchased and not the promotions offered in the supermarket. This purchase-based nature of existing data sets such as this one has prevented researchers from measuring the frequency of retail promotions (Nakamura et al. 2015).

This study analyses only the promotional purchases recorded and not the available offers in a supermarket. As mentioned in the introduction, this study makes use of scanner household purchase data, which reveals information on retail promotions as part of a marketing strategy across retailers. It is vital to highlight that the prevalence of retail promotions among household purchases is a combination of both the frequency of these promotions on products applied but also the consumer's response to them. Purchase data does reflect the retailer's applied promotions partly because they are offered on products which have been purchased by the consumer and the scanner data underlines that the strategies have been applied successfully. Therefore, the data includes the supermarkets offering a product under promotion and needs to be purchased by the household to appear in the scanner dataset. However, the

data does not reflect the availability of promotional offers nor includes information on the frequency and duration of promotions, marketing intensity, competitive reactions from other retailers or manufacturers, and purchase-specific shopper characteristics such as deal-proneness (Taillie et al. 2017, Kaur et al. 2020). All above mentioned characteristics of the data is important to acknowledge and the retail environment would be better characterised by food availability data than food sales data.

How are the data used in the thesis?

This thesis investigates the Kantar Worldpanel dataset from two perspectives: the retailer applying the promotions to certain products in their stores and the consumers purchasing these promoted products that have been offered by the retailer. This examination of the supply side and demand side of the use of supermarket promotions is a novel feature of this study. Due to the vast amount of data and data components, Table 3.10 aims to offer a structure of the thesis and the empirical chapters based on the knowledge of the chapter and the insights gained on the complexity of the dataset.

Table 3.10 Overview of empirical chapters.

	Research question	**Unit of analysis / primary variables of interest**
Chapter 4	What type of breakfast cereals are more likely to be promoted in a supermarket? Investigates the factors that increase the probability that a product is sold under promotion by retailers	Product-level analysis through fractional multinomial logit 1. All products 2. Health status 3. Brand status Product information + aggregated shop and household information
Chapter 5	What factors influence the household purchases of breakfast cereal? Investigates the influence of factors on the quantity of breakfast cereal purchased / consumption by households	Household-level analysis through quantile regression 1. High and low **consumption** 2. High and low consumption plus interaction terms Household information + aggregated product and shop information
Chapter 6	How can policies encourage healthier breakfast cereal purchases? Investigates the influence of factors on the healthiness of purchased breakfast cereals by households	Household-level analysis through quantile regression 1. **Healthiness** of households Household information + aggregated product and shop information

3.5. Description of purchase database

Retail promotions and patterns in the Scottish purchase data

The following section describes the purchases made in 2015. Out of 52,524 purchases, 19,394 have been products sold under promotion. It is important to present the results in the descriptive statistics knowing that the purchases give more details towards the purchase behaviour than just the products that have been used due to the fact that purchases include the frequency across 52 weeks by all households in the panel. The first part will focus on a data description comparing the promotion aspect such as on/ off promotions as well as promotion types underlining the importance of including promotion types later in the analysis. Table 3.11 shows the comparison of on-promotion purchases against price and volume promotion separate based on key metrics in food retailing.

Table 3.11 Comparison of retail promotions across key metrics of retailing.

	On promotion (Observations 19,394)	**Price promotion** (Observations 15,240)	**Volume promotion** (Observations 4,154)
	Mean (SD)	**Mean (SD)**	**Mean (SD)**
Shelf price (100g)	0.533 (0.302)	0.515 (0.262)	0.598 (0.411)
Promotional price (100g)	0.352 (0.213)	0.323 (0.143)	0.461 (0.349)
Promotional depth (£)	0.320 (0.014)	0.342 (0.146)	0.237 (0.106)
Weight in gram	559 (247)	574 (234)	504 (282)
UK FSA (average)	1.011 (4.102)	0.974 (4.174)	1.146 (3.825)
Branded label (prop.)	0.792 (0.405)	0.790 (0.406)	0.800 (0.399)

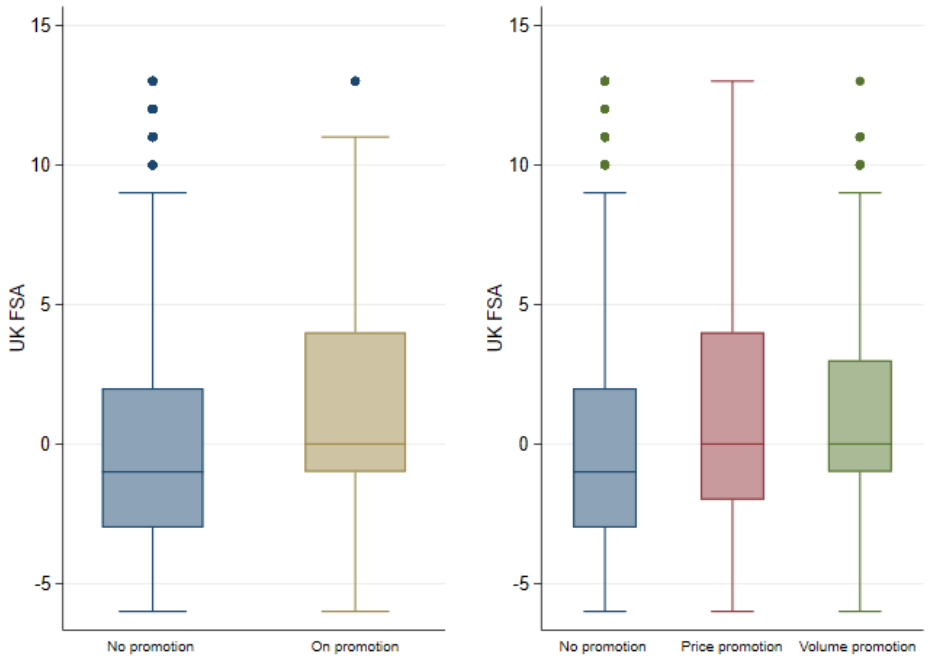
This table shows that the on promotion does not reflect the differences that price and volume promotion make separately as the on promotion metrics are evened out the differences of price and volume promotion. Only through separating the overall promotion by promotion types gives the details and insights that are needed to assess the influence of retail promotions. Key metrics of food retailing are used to describe the differences across on-promotion, price promotion and volume promotion. The shelf price (also called full price) is defined as the price given on the supermarket shelves and does not include any promotional discounts. The promotional price is the price of products includes the promotion that is applied. Therefore, the shelf price is the same as the promotional price in the absence of promotions, however the promotional price represents the price that the consumer pays when purchasing a product under promotion. The third key metrics is the promotional depth, which is the difference in percent between the shelf price and promotional price. The table also includes weight, UK FSA score, and brand status as they are key characteristics included in the analysis.

The shelf price per 100g shows £0.53, however the price promotion purchases have a lower full price and the volume promotion a higher full price of the product (0.51 compared to 0.59). Another difference that can be revealed is the promotional price: on promotion it is 0.35 per 100g, however it is

0.32 for price and 0.46 for volume promotion. This shows that volume promotions have a much higher promotional price compared to price promotions per 100g. Another significant difference between price and volume promotion is the promotional depth applied through the discount. On average across price promotions the price discount is £0.34 but £0.23 on a volume promotional discount – therefore much lower. Two key product characteristics that will be analysed in this study, which are the brand and the health status of a product. Volume promotions are on average less healthy than price promotions compared to the average of all purchases made under promotion in general. Also, the proportion of branded products is higher for volume promotion compared to price promotion. Another interesting product characteristic is the weight of the product. On average a product sold under promotion weights 559g, a price promotion 574g and under volume promotion 504g. Therefore, the descriptive statistics show that volume promotions have a higher promotional price per 100g, on average a lower discount but also are applied to less healthy products compared to price promotions. These differences could not have been picked up by simply comparing on and off promotions.

Figure 3.6 gives more insights to the spread of the healthiness based on the UK FSA Score of products across applied promotion types (on promotion, price promotion, volume promotion) making use of a boxplot. It underlines that the on-promotion does not show the strong differences that are found across price and volume promotion and the spread of the UK FSA scores. The purchases under price promotion vary more across the less healthy scores (reaching from -6 to 13) compared to volume promotion (from -6 to 9 plus outliers) indicating that price promotions are applied more across unhealthier products.

Figure 3.6 UK FSA score of purchases across promotion types.



Source: own elaboration based on Kantar Worldpanel data

Adding the healthiness of the products purchases to the retail promotions (Table 3.12.) underlines the importance of including a health score for each product in the dataset. The table clearly highlights the following: First, the information given by on/off promotion is not sufficient. On promotion simply gives an indication of how many breakfast cereals were purchased under promotion in 2015, which were 37%. Second, healthiness of a products is a crucial characteristic when examining the role of retail promotions. Out of all purchases, 21% purchased products are categorised as less healthy through the UK FSA nutrient profiling score. Third, combining price and volume promotion types across the health status is the key for this study. The table indicates that of the healthy purchases 33.7% have been bought under promotion compared to 50.5% across unhealthy purchases. However, the distinction of promotion types offers greater insights. Price promotions account for 26.1% of healthy purchases but 41.3% of less healthy purchases. Further, volume promotions account for 7.6% among healthy purchases and 9.2% of less healthy ones. This suggests that healthier purchases are made more under no promotion, whereas the majority of less healthy products is purchased on promotion (50.5%), especially 41.3% under price promotion. Of healthy products only 26.1% are bought with a price promotion. The descriptive table indicates that promotions are purchased (and applied) more to less healthy products, especially price promotions.

Table 3.12 Description of the purchases made under promotion by health status of products.

	Healthy purchases (41,493)	**79%**	**Less healthy purchases (11,031)**	**21%**	**Total purchases (52,524)**
No promotion	27,501	(66.3%)	5,451	(49.5%)	**32,952**
On promotion	13,992	(33.7%)	5,580	(50.5%)	**19,572 (37.2%)**
Price promotion	10,828	(26.1%)	4,561	(41.3%)	**15,389**
Volume promotion	3,164	(7.6%)	1,019	(9.2%)	**4,183**

3.6. Conclusion

The descriptive statistics of the database give reason to elaborate further on the differences across promotion types and justifies looking into price and volume promotion separately in the analysis because it is already highlight how they differ in the description of the data. On-promotion and off-promotion is not detailed enough for the purpose of this study. The database description underlines the important role of retail promotions and the need to further include promotion types in the analysis. Overall, the descriptive statistics indicates that promotions are purchased and applied more to less healthy products, especially price promotions. The purchases under price promotion vary more across the less healthy UK FSA scores compared to volume promotion indicating that price promotions are applied more across unhealthier products. It highlights that the healthiness of the products purchased matters but also that the brand status of a product plays an important role and will be investigated further.

Chapter 4

4. The role of retail promotions from a retailer's perspective

4.1. Introduction

What factors influence the likelihood that a breakfast cereal product is sold under promotion? Do certain characteristics have a different impact on the likelihood that a product is sold under a certain promotion type? Does the brand and health status of a product play a role when retailers apply a price and volume promotion to a breakfast cereal product? Furthermore, do certain socio-economic characteristics increase or decrease the responsiveness to supermarket promotions? This study considers these questions within a broader investigation of how retail promotions and various factors are linked to products sold by the retailer and investigates the promotional strategies through the lens of the retailers in Scotland analysing scanner data of household purchases.

This chapter aims to provide a review of the literature on retail promotions from a supply side orientation. In doing so, the role of promotions from the retailer's perspective is explained, especially considering the health and brand status of a product. This empirical chapter seeks to 1) describe the probability that a product is sold under a certain promotion by household purchases of the key food group breakfast cereals; 2) examine whether households with certain socio-economic characteristics are more likely to be targeted by promoted products through the retailer; and 3) characterise the association between different promotion types and the nutritional profile of the product 4) and to characterise the association between different promotion types and the brand status of the product. To address these aims the research question will be answered through looking at product-level data and a fractional multinomial model to investigate the probability that a product is sold under a particular promotion.

The study contributes knowledge to existing literature and studies in a number of ways. First, it investigates across retail promotion types and their influence on purchases, differentiating by different

promotion types comparing price and volume promotions and their distinguished effect. The thesis looks at the retailer and consumer perspective through the same dataset, however this chapter examines the supply side whereas the demand side will be analysed in Chapter 5. In addition, this study uses the UK FSA nutrient profiling score to assess the healthiness of each product in the dataset. Moreover, the adoption of non-linear models represents another important contribution to the literature from a methodological point of view.

The rest of the chapter is organised as follows. Section 4.2. presents studies on retail promotions and how they are applied across health and brand status. Section 4.3. elaborates the methodology including a summary of findings from food economics literature, introduces the method fractional multinomial logit model and describes the aggregated product-level data and section 4.4. reveals the empirical results and wraps up with remarks confirming the rationale of the thesis. Section 4.5. concludes the chapter.

4.2. The prevalence of retail promotions in the United Kingdom

Price is a critical influence on food purchase decisions made by consumers in the retail environment, and, therefore, retail promotions are likely to be a crucial factor influencing dietary patterns as promoted offers change the price of a good. Studies on the impact of retail promotions on UK sales found that purchases of promoted products in Britain accounted for 40% of all food and drink take home expenditure in 2016 reaching the highest proportion across Europe. On average, over a fifth (22%) of promoted products are purchased by shoppers, which is considered to be additional to the expected volume of the food and drink category meaning that approximately one-fifth of promoted products are purchased additionally to what would be expected without the promotion (Smithson et al. 2015). Looking at country specific data, in Scotland in 2018 28.5% of food and drink volume was bought on promotion, whereas in 2016, 33% was reported by Food Standards Scotland compared to an overall UK result of 40%. This is potentially due to changes in market trends, including the rise of discount retailers offering 'every day low prices' and less discounts. Nonetheless, price promotions are still very prominent in Great Britain, and promotional purchasing continues to be one of the highest in Europe (Coker et al. 2019). This finding is supported by sugar reduction, as the decline has largely been driven by shoppers' purchasing more in discounters, and further with other retailers also adopting more low price strategies. Because discounters tend not to promote extensively, the average amount sold on promotion has gone down because they offer low price items, which do not account for promotional purchases and therefore do not appear in the datasets on promoted purchases.

In the United Kingdom, the role of promotions plays a crucial role considering that the retail price of food increased over the ten-year period 2002 to 2012, with prices of healthier foods increasing the most. This phenomenon could explain a decline in the nutritional quality of food purchases amongst pensioners, households with young children as well as lone parent households (Purdam et al. 2016).

The price of food plays an important role in less healthy consumption patterns, especially of low-income households, because foods of lower nutritional value generally cost less per calorie (Darmon and Drewnowski 2008; Drewnowski and Fulgoni 2008; Appelhans et al. 2012; Pechey and Monsivais 2015).

The body of evidence strongly suggests that retail promotions both temporary price reductions and multi-buy volume promotions, increase the volume of food or drink purchased during a single shopping trip in the UK (Martin et al. 2017). However, the differentiation between promotion types is vital as price and volume promotions are applied differently by retailers as retail promotions drive short-term behavioural changes and encourage consumers to purchase more than expected. A research project for Public Health England conducted by Kantar Worldpanel UK examined the effect of promotion types on sales and found that multi-buy promotions generate the greatest sales increase compared to temporary price reductions. The increase for multi-buy type promotions ranged from 29% of sales (from a 5–15% discount) to 35% of sales (for 45–50% discount) compared to 20% (from a 5–15% discount) and 25% (for 45–50% discount) for temporary price reduction (Smithson et al. 2015).

4.2.1. Retail promotions applied across the health status of products

Research has shown that promotions applied on foods in supermarkets are disproportionately promotion on products that are energy-dense, nutrient-poor and often considered less healthy. The promotions are for instance used in catalogues or circulars, but also within the retail environment such as in-store through checkouts, end-of-aisle displays or positioning in the shelves. All of these marketing techniques are used to increase sales, however neglect the fact that it influences consumers to purchase more less healthy foods. Retail promotions such as multi-buys or other upselling strategies encourage consumers to purchase more than they intended when entering the supermarket. During one year the average person will consume additional 17,000 calories due to upselling, multi-buy offers and supersized products. The applied strategies are money saving methods however often at the expense of healthy choices.

In the literature, supermarket promotions have been investigated among different promotion types and healthiness of products. However, Cameron et al. (2016) report that 74% of studies related to the effect of supermarkets interventions on product healthiness were conducted in the USA therefore this study will shine some light on supermarket promotions and the influence on healthy and less healthy food consumption in the UK and especially Scotland. Several studies have examined price promotions on the purchase of healthy and unhealthy food and this section summarises the relationship of promotions and product healthiness in the current literature (Steenhuis et al. 2011; Nakamura et al. 2015; Cameron et al. 2016; Powell et al. 2016; Ejlerskov et al. 2018b). There are a limited number of studies that have looked at the health status (nutritional composition) of foods promoted to consumers and research findings have been inconsistent. However, comparisons are difficult to establish because the nature of the data is different, which includes for example advertised data compared to purchased

scanner data or the method that is used to assess the healthiness of the promoted products. Therefore, it achieves different and often not comparable results (Safefood 2019). Kaur et al. (2020) reports in their systematic review no consensus in the very limited literature with regard to whether price promotions are more likely to be found on healthy or unhealthy food and drink in upper-mid to high-income countries. Further, they acknowledge being unable to distinguish between price and volume promotions having found a lack of data in the analysis of the available literature. Moreover, they mention that the prevalence of price promotions seems to be very context specific as European studies report a higher prevalence compared to studies conducted in North America.

A review by Bennett et al. (2019) offers a comprehensive summary of the recent literature on the prevalence and influence of price promotions for healthy and less healthy foods and beverages. They find evidence across 16 studies that price promotions are more frequently applied to less healthy compared with more healthy foods and beverages in high-income countries. The literature states that price promotion have been linked to an increase in purchases suggesting that the impact is greater for less healthy food options. Riesenberg et al. (2019) discover in their study that price promotions have been used more frequently on less healthy food categories (29%) compared to healthy ones (15%) and that the magnitude of discount is greater for less healthy food categories; on average 26% compared to 15% for healthy food categories. They link their analysis to the nutrient profiling system used in Australia and New Zealand (Health Star Rating) and conclude that the healthier the products the lower the average magnitude of discount and price promotion frequency. Examining US data, (Powell et al. 2016) study the price promotions on food and drinks in the US and investigate the prevalence and patterns of price promotions by supermarket type, product package size and product healthiness as well as the depth of price reductions. Through the analysis of two-year (2010-2012) price data across a nationwide US sample of supermarkets and grocery stores, healthier food categories are shown to have lower prevalence to be under promotion compared to unhealthy categories. They claim that less-healthy products such as sugar sweetened beverages (18%), high-sugar cereal (18%), snacks and sweets (15%) and larger product package sizes have a higher prevalence of price promotion. For instance, the lowest prevalence has been found for fruit and vegetables with 9%. Further, (Taillie et al. 2017) investigate the price promotions on healthy and unhealthy foods and found consistent result with the current literature for example (Powell et al. 2016): lower prevalence of price promotions is found on healthier food categories. Ready-to-eat-breakfast-cereal and sweet snacks are associated with the highest promotional prevalence while vegetable and fruit with the lowest prevalence.

A recent report by Safefood Ireland (2019) mentions the inconsistency in the finding for the healthiness across promoted food products concluding that for example US and Dutch studies find that promotions favour processed, high protein and energy dense foods, whereas in the UK promotions were also found on products that are more considered healthy. Ravensbergen et al. (2015) document in their study across Dutch supermarket flyers that 70% of all price-promoted foods where less healthy products. Another study documents neither difference between the healthiness and promotion types nor

significant gap in the frequency of promotion by the healthiness of products. Yet, an increase in sales of price promoted products is associated more in less-healthy categories compared to healthier categories with a price promotion in the United Kingdom (Nakamura et al. 2015). These inconsistent results underline the need for context specific and data related comparisons of results and therefore, the following section focusses on studies based on UK data only. Further to the author's knowledge, the distinction across promotion types has barely been found in studies and several studies mention the need for the comparison across retail types in their limitations and future research (Nakamura et al. 2015; Revoredo-Giha et al. 2018; Kaur et al. 2020).

An overview of recent studies that used the same dataset as this thesis, namely UK Kantar Worldpanel, all state that less healthy products seem to be promoted more than healthy ones. Coker et al. (2020) show in their report using UK Kantar Worldpanel data a greater proportion of price promoted purchases for unhealthy food and beverage compared to healthy. Another study analyses UK Kantar Worldpanel household panel purchase data and concludes that a price promotion increases the spending of household expenditure up to 10% among less healthy food categories compared to more healthy categories (Revoredo-Giha et al. 2018). Nakamura et al. (2015) find in their study that sales uplift from price promotions is larger for less healthy food categories compared to healthier ones after controlling for reference price, price discount rate, and brand specific effects with this effect being most marked among individuals from the lowest socio-economic group. McDonald and Milne publish studies for the Scottish Food Standards Agency of retail promotions. In a follow-up study in 2018, they report that across all price-promoted purchases the highest has been found for unhealthy food groups such as crisps and savoury snacks (53%), puddings and desserts (45%), confectionary (48%), sugar-sweetened soft drinks (52%), and biscuits (44%) (McDonald and Milne 2018).

Little research on volume promotion (i.e., multi-buys) has been investigated for the United Kingdom, often due to a lack of detailed data. When looking at specific food categories, soft drinks, and dairy products, and bakery products are heavily promoted by multi-buy deals whereas fruit and vegetables and alcohol use an almost even mix of price cuts and multi-buys and "buy one get one free" items are skewed more towards unhealthy products. Nakamura et al. (2014) investigate the impact of a ban on multi-buy promotions in Scotland and analyse the change in purchase behaviour before and after the ban on alcoholic multi-buy drinks. Using the Kantar Worldpanel data for Scotland and comparing it with England and Wales, they observed in the short term (meaning 9 months post-intervention) the ban of multi-buys in Scotland has failed to reduce the volume of purchases on alcoholic drinks like beer and wine. However, their research only focusses on alcoholic beverage and would be useful to expand across less healthy food categories for future research. Chandon and Wansink (2002) discover that multi-buys on processed food promote stockpiling and therefore increase consumption and that volume promotions linked to an increased consumption of less healthy products is dangerous when trying to tackle the obesity crisis among adults and children.

To conclude, based on their review of the recent literature, Bennett et al. (2020) also suggest that the potential influence of price promotions on consumer purchases is greater on less healthy products compared to healthier food and beverages. However, the causal relationship between cannot be clearly identified. Moreover, they report that the role of socio-economic characteristics of the household is unclear in the literature. This will be examined further in this thesis looking at the influence of household characteristics on healthy and less healthy purchases across promotion. Further, they state in their study that it is very common that price promotions are applied by retailers and/or manufacturers on less healthy products and that this finding is consistent. A possible explanation for this might be that higher profit margins are achieved on less healthy foods and therefore the manufacturers and retailers are able to lower the prices further. Another possibility is that the retail environment simply adapts to the greater consumer demand for less healthy price-promoted food and beverages. Overall, the review supports the recent call by the literature to limit and restrict price promotions on less healthy foods and beverages to improve the diet and health of the population (Bennett et al. 2020).

It is clear from the literature review that promotions are generally more prevalent on less healthy food categories or products for instance confectionary and high sugar products. Regarding breakfast cereals, the highly sugary ready-to-eat breakfast cereals are often promoted most targeting children. Linking this to the evidence that the influence of retail promotions is strong in general and realising that the literature hardly distinguishes between promotion types or summarised on/off promotion, this study will differentiate between promotion types. This again demonstrates a novelty of this study and emphasises the value it contributes to the literature.

4.2.2. Retail promotions applied across the brand status of products

One important characteristic when dealing with food products in the retail environment is the brand of the product itself and can be distinguished by national branded and private label products. In the FMCG industry, two trends developed over the last decades, which have transformed to a fixed characteristic in the market. On the one hand, the increased use of retail promotion on branded products and on the other hand the growth of private label product on the shelves in supermarkets. Branded products, in the literature often referred to as national brands, are the products with a brand by a manufacturer, in contrast to private label products or retail brands, which are a retailer's own brand and exclusively sold in their own supermarkets. In the past, private labels have been perceived as cheaper products with poor quality, however in recent years retailer brands developed a broad portfolio including low cost, mainstream and premium versions of a product (Mauri et al. 2015). The development of private labels in the past has changed from basic copies of national brands to brands that even exceed the quality and has established private label sub brands targeting consumer that look for attributes such as premium, healthy or budget. The quality of private label products is comparable to national brands and retailers aim for higher-income consumers with their premium private label brands (Volpe 2011).

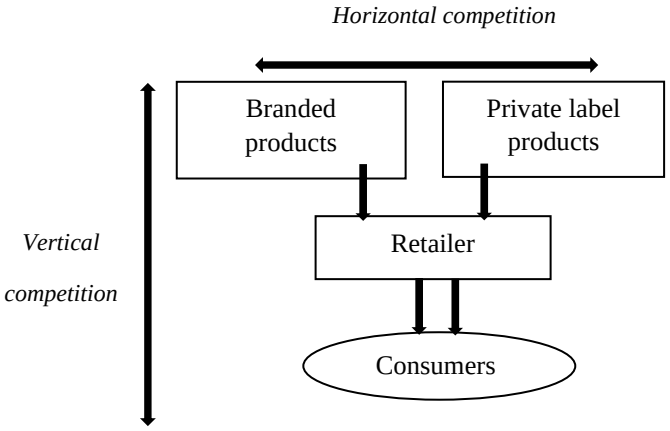
In the United Kingdom, the private label products are very dominant such as “Tesco Value” and “Sainsbury Taste The Difference” are a key characteristic of the British FMCG industry compared to other European countries. According to IRI (2015) half of the British retail sales are purchases with a private label (51%) compared to 43% in Spain, 34% in Germany and 18% in Italy. Individual country performances vary widely with private label value share, being the highest and growing the most in the UK (52.5%), which has been increasing for the fourth consecutive year. This can partially be explained due to the trend of increasing food prices leading to consumers switching to private label brands but also because premium ranges are expanding and increasing their quality (IRI 2018). Especially considering squeezed incomes of consumers, linked to higher food prices for example due to rising inflation, the role of promotions will be even more important in the future. Further, rising prices for manufacturers and retailers along the supply chain, will have an influence the prevalence and depth of promotions as longer-term deals are starting to impact suppliers. Therefore, promotions have a strong impact on the manufacturer and retailer relationship, needing to work more closely together to reach consumers across various income groups, but also be able to create a stand-out with both branded and private label brands on one shelf.

Supply-side and brand status of a product

The introduction of private label products has a major impact on both retailers and consumers. From a retailer perspective, the private label products were introduced as a strategy to increase and improve the store image as well as improve store loyalty by offering differentiation among retailers. Through private label products the retailer can expand the product category and can lead to more profitability for the store including higher unit margins and potentially high sales volume. Retailer gains higher margins on private labels compared to national brands due to the fact that they produce the private label products from unbranded manufacturers operating at lower costs (Ailawadi and Harlam 2002; Karray and Martín-Herrán 2019). From a supply side, retailers try to find a successful combination of private and national brands, because the lower price of the private labels leads to increased traffic of more price conscious customers in the store, however many consumers trust national brands more due to quality reasons. Both types of brands are of high importance for the retailer; national brand consumers generate higher store traffic and for private label products the store is able to gain higher margins (Ngobo 2011). The reason retailers are so in favour for private label products not only because of the increased profit, but also the higher margin for private label and increased category expenditure through price and non-price promotions. Private labels also mean lower manufacturing costs, inexpensive packaging and limited marketing costs (Akbay and Jones 2005). The lower marketing costs include less spending on Research & Development, product launch and less image building, which therefore means less risks for implementing new private label products. Moreover, successful private label products can build an exclusive positive store image and boost store loyalty for the whole retail chain (Hyman et al. 2010). The increased popularity of private label products has impacted the national brand manufacturers by

minimising the shares and the margins due to the competition lowering retail prices of the national brands and the price competition across the whole category. The private labels give the retailer more bargaining power against manufacturers in terms of delisting national brands but also controlling prices and promotions (Volpe 2011).

Figure 4.1 Branded and private label products competition.



Source: Dobson and Chakraborty (2015)

The relationship between a manufacturer and a retailer is about co-operation to creating value through their complementary roles in providing goods to consumers. A mix of horizontal and vertical competition has been described in Figure 4.1. The retailer serves as a distributor to consumers selling manufacturer's products but further both trading parties compete for how the value is shared, such as profits (Dobson and Chakraborty 2015).

Demand-side and brand status of a product

As part of the importance of brands compared to private label products, brand familiarity moderated by marketing effects includes the consumer's degree of direct and indirect experience of a product and a brand. Familiar brands build a stronger and accessible knowledge structure which provides consumers with less effort in processing information about the brands (Lee and Yi 2019). From a consumer perspective, the national brands represent quality from a trustworthy brand and stands for reliability and frequent improvements, whereas private label products stand for a better value for money, but also for an authentic and honest choice and offering extra variety besides the national brands (Dobson and Chakraborty 2015). Advantages of the increased number of private labels from a consumer's point of view are lower prices and an increase in product choices that are available through increased competition on the market. The price for private labels is on average 23 % lower than branded products in the US (Volpe 2011). Consumers, who switched from a national brand to a private label, have been

found to improve their perception of the quality and price ratio of private labels and are difficult to win back from a branded manufacturer's side. To regain consumers, studies mention that the strategy of the manufacturers should be a price cut, promotional benefits or the development of new products (Abril and Sanchez 2016). Olbrich et al. (2017) examine the impact of price promotions on private labels. From a consumer's point of view, promotions on private labels represent, compared to branded products, a strategic attempt to increase sales of rarely purchased products quicker. Moreover, promotions do not have the same impact on branded versus private labels because consumers who buy private label products prefer not to compare prices and therefore seek prices that do not vary.

Income plays a significant role in consumer's purchases decisions and lower income households are facing more constraints of income and therefore try to maximise utility including making purchases more careful, but also buy more private label products and national brands mainly if packages are larger in size or under a promotion (Akbay and Jones 2005). They find that lower-income consumers prefer low-priced private label brands and therefore often purchase national brands only under a promotion, as a large package size or as a careful purchase decision. However, higher-income consumers purchase more national branded products and show less elastic demand for all products compared to lower-income consumers. Over the years, the development across private label products ranges across a wide price-quality spectrum – economy (generics), standard (also referred to as a "copycat") and premium private label brands. While the quality perception has adjusted between national brands and premium private label products, the latter are still perceived as better value for money compared to the former.

Effectiveness of promotions across brand status

When comparing the effect of retail promotions on private versus branded products, price promotions are found to be less effective on private labels compared to brands and discounts on branded items have a stronger impact on the purchases compared to private labels (Cotterill et al. 2000; Bogomolova et al. 2015; Gauri et al. 2017). Bogomolova et al. (2015) investigate supermarket promotions on private and branded labels comparing US and UK data. One of their research questions deals with the prevalence and intensity of supermarket promotion types between branded and private labels and their findings indicate that sales under price promotion during 2005-2012 in the UK were twice as prevalent for branded products compared to private labelled products. Moreover, the intensity of the discount differed as well. The discount was greater for branded products, but a change has been found across all years (30% during 2005-2007 and 31% during 2008-2012) compared to private labels (10% and 18% during 2005-2007 and 2008-2010 respectively).

Retail promotions being less effective for private label brands compared to national brands might be explained by the fact that the private label products are low price tier brands, which have a smaller promotional price elasticities. Olbrich et al. (2017) examine the impact of price promotions on private labels. From a consumer's point of view promotions on private labels represent, compared to

branded products, a strategic attempt to increase sales of rarely purchased products quicker. Moreover, promotions do not have the same impact on branded versus private labels because consumers who buy private label products prefer not to compare prices and therefore seek prices that do not vary. Being a cheaper brand in the retail environment, promotions have been used much less compared to branded products, however the growth of private label across all price tiers shows an increase of price promotions applied to private label products (Bogomolova et al. 2015). Moreover, interestingly the authors find that in the US private label brands were just as likely to be promoted compared to national brands, and even hardly different in the depth of the discount, whereas in the UK the prevalence of promotions was twice as high for national brands and the depth of the discount was far greater compared to private label brands (Bogomolova et al. 2015). In the US, Ailawadi et al.(2009) compare national brands and private labels and also document higher effectiveness of promotions on national brands than private store brands. Again, this finding underlines how country and context specific the analysis needs to be to receive comparable results. Another interesting study shows that price promotions are an effective short-term strategy to increase sales among national brands but in the long-term research suggests that the price promotions on national brands lead consumers to be more prone to buy private labels (Dawes and Nenycz-Thiel 2013). Analysing UK data on premium private label and value private label products, the authors conclude that premium private labels are different from value private labels in price, packaging and advertising. A high intensity of price promotion might reduce the internal reference prices among consumers and lead to searching for cheaper offers which is often a private label product (Nenycz-Thiel and Romaniuk 2016).

The brand status of a product is a key attribute for both the supply and demand side and this study investigates how the product characteristic "branded or private label" influences the likelihood to be sold and bought under promotion in retailers across Scotland. A Scottish report has reported that 22% of the private label products purchased into the home in 2018 were purchased on promotion whereas the figure was 43% for the branded products. The study of Scotland reduces however all promotion types to on promotion versus off promotion instead of differentiating by promotion type (Campbell et al. 2020).

4.2.3. Retail promotions applied across further dimensions

(i) Product characteristic: package size

Besides the brand and health status of a products, another characteristic has been discussed in the literature as an important factor that influences promotions: The size of the package. Food packaging plays an important role in the supermarkets. All packaging elements attract the attention of the consumer and influence the purchase decision. Packaging elements are for example the shape, colour and the package size. This study focuses on the package size as one of the product characteristics. Several studies have examined the concept of downsizing packages especially on unhealthy foods to prevent

the consumer from eating more. It has been found that the consumers, who are exposed to larger sized packaging, increase the food consumption, which implies that smaller packaging could reduce the food intake. Further, the elimination of larger packaging could have an impact on the diet of reducing the average daily energy consumed among UK adults by 12-16% (Marteau et al. 2015).

However, the influence of supermarket promotions on package size has hardly been investigated. Powell et al. (2016) observe that larger product package sizes "family-sized" have a higher prevalence of price promotion compared to the healthier and smaller products. Their study additionally examines the package size of price-promoted food and beverages and highlights that for example family-sized packets of potato chips and juice drinks containing less than 50% fruit juice are price promoted to a greater extent than their respective smaller individual counterparts. Ghosh (2017) investigates the purchases of package size across different promotion types (use of manufacturer coupons, price cuts featured on flyers or newspaper inserts, in-store displays, temporary in-store price reductions). The author finds that consumers that use supermarket promotions such as displays, and price discounts tend to purchase larger packages in contrast to consumers that prefer featured price cuts in flyers and coupons purchase smaller packages. A study by Fowler in 1982 looks into the influence of branded and private label products and package size under price promotion on purchase decisions of the consumers and mentions the riskiest choice, from a consumer's perspective: purchasing a low priced, discounted and unfamiliar product in a large package size. The results indicate that the size is not statistically significant, but brand and discount are. Moreover, consumers generally prefer the branded products and the private labels are more rejected in larger packages with a great discount, which can be explained through the riskiest choice for a consumer. Besides, the importance of other variables when dealing with package sizes of products such as household size, storage space at home, shelf life of the product itself, re-sealable package, and the rate of use, should not be underrated.

As this study deals with the food category breakfast cereal, it is necessary to examine the role of package size in this category because is especially sensitive to size of the product package which varies greatly. For example, Kellogg's Frosties is available in the retailer environment across different markets in up to 10 different sizes in grams. The literature clearly underlines the importance of packaging as a product characteristic and its influence of the purchase decision therefore the weight of the product is included in the analysis. A few studies have investigated the link between the food category breakfast cereals and applied retail promotions (Empen et al. 2015; Powell et al. 2016; Taillie et al. 2017) and the gap is highlighted in this study.

Taillie et al. (2017) report in their study investigating a IRI US dataset from 2008-2012 that in the food subgroup Ready-To-Eat-Cereals (RTEC) had the highest proportion of price promotions compared to all other categories used in their research, which were 45% in 2012. While Taillie et al. (2017) discover a predominance of RTEC among price promoted cereals, Powell et al. (2016) differentiate even among high and low-sugar cereals. They point out that higher-sugar breakfast cereals (12.9%) were more often price promoted than lower-sugar cereals (8.7%) and besides that, that the

discount applied through the promotion was larger for higher-sugar (–23.7%) than lower-sugar (–13.4%) cereals. Further, Empen et al. (2015) found in their German study on breakfast cereal and promotions that they are on promotional sale every 10 to 20 weeks with an average price reduction ranging from 7 to 15%.

(ii) Shop characteristic: Store type and online

The use of promotions across supermarket types is essential as it differs strongly based on the category. The benefits of using promotions for the retailers has been explained in the literature review in section 2. The study includes further shop information aggregated by product level giving a tendency across different store types as well as online shopping. Frequently in the literature, retailers have been broadly categorised into either as high-low pricing (HiLo) or as everyday low-pricing (EDLP) shops. HiLo shops use promotional activities as part of their price strategy whereas EDLP stores use consistent pricing to receive constant margins. EDLP is characterised by stable prices and the absences of supermarket promotions and therefore it is unlikely that prices drop in "everyday low prices" supermarkets through promotions. As an example of the UK market, Asda is an "everyday low price" positioned retailer and more price focused (Lan and Dobson 2017; Olbrich et al. 2017). Ravensbergen et al. (2015) document that discounters had higher percentages of unhealthy food discounts compared to traditional supermarkets. This can be explained by the fact that prices in discount supermarkets are kept consistently low and do not focus on special offers. On the other hand, higher socio-economic group households, who shop in traditional supermarkets with higher food prices, are exposed more to price promotions and this could be one reason why they purchase more under price promotion because the supermarket's strategy "HiLo" includes regular price changes through promotions (Smith and Sinha 2000; Olbrich et al. 2017).

Price promotion intensity as part of retailers' pricing decisions deal with the frequency, depth and duration of the promotional discount from a supply side perspective, which influences the price that the end consumer pays for a specific product. The literature largely agrees that retailer price promotion intensity was higher for supermarket chains that are larger and follow a HiLo strategy. Moreover, products with a long storability and a high level of necessity, have a high promotion intensity as well as high preference for brands which are promoted more often. All in all, HiLo and larger chains as well as larger stores have a higher price promotion intensity and coordination, which includes promotional displays and features which may be combined with a price discount (Smith and Sinha 2000; Olbrich et al. 2017). Ravensbergen et al. (2015) emphasise that discounter supermarkets have higher percentages of price discounts on unhealthy products compared to traditional supermarkets. Another study supports this finding: Black et al. (2014) conduct a cross-sectional survey of 601 retail food stores (including supermarkets, grocery stores and convenience stores) in the United Kingdom and find that large and premium supermarkets offer the most healthful shopping environments for consumers, whereas less healthful environment has been linked to discount supermarkets and convenience stores.

Among various supermarket types, acknowledging the distinction between in-store and online food shopping is important. According to the Kantar Worldpanel (2016), the United Kingdom is the third largest adopter of online grocery shopping, in the world, after Japan and South Korea, which has the largest online FMCG market and the UK e-commerce grocery market accounted for 7.3 % of all total grocery retail sales in 2016, increased from 6.7% the year before (Kantar Worldpanel 2016). A study claims that the UK has one of the most developed internet food shopping in the world (Hand et al. 2009). Lennon et al. (2009) looking into the motivation of purchasing products online and report that convenience is the primary reason for buying food online and physical constraints is the second. Convenience is found to be more important than variety or the purchase price when consumers shop online. Hand et al. (2009) examine the influence of situational factors on online grocery shopping. They offer some reasons why people start to shop online, including for example a change in the family circumstances, health problems and mobility problems. However, what stops people from purchasing online are for example better prices in-store, expensive delivery charges or problems with the internet order. For this study, it is necessary to understand why consumers choose to shop online and how this might have an impact on purchases under different promotion types.

To conclude on the literature review about the prevalence of retail promotions in the UK and differentiating across health and brand status of a product, the following can be summarised: Price is a critical influence on food purchase decisions made by consumers in the retail environment, and, therefore, retail promotions are likely to be a crucial factor influencing dietary patterns as promoted offers change the price of a good. Studies on the impact of retail promotions on UK sales reveal that purchases of promoted products in Britain account for 40% of all food and drink take home expenditure in 2016 reaching the highest proportion across Europe. In Scotland in 2018 28.5% of food and drink volume was bought on promotion, whereas in 2016 33% was reported by Food Standards Scotland, and the decline might potentially be due to changes in market trends, including the rise of discount retailers offering ‘every day low prices’ and less discounts. Research has shown that promotions applied on foods in supermarkets are disproportionately promotion on products that are energy-dense, nutrient-poor and often considered less healthy. Retail promotions such as multi-buys or other upselling strategies encourage consumers to purchase more than they intended when entering the supermarket. During one year, the average person will consume additional 17,000 calories due to upselling, multi-buy offers and supersized products. The applied strategies are money saving methods however often at the expense of healthy choices. When comparing the effect of retail promotions on private versus branded products, price promotions are found to be less effective on private labels compared to brands and discounts on branded items have a stronger impact on the purchases compared to private labels. This empirical analysis considers the health and brand status of breakfast cereal product and investigates what type of products are more likely to be promoted by retailers distinguishing by price and volume promotion.

4.3.4. Research gaps on product-level literature

Looking at the recent literature on the role of promotions from a retailer perspective and the prevalence of those, the current literature does not fully answer the research question. The prevalence of promotions in United Kingdom is high with retail promotions accounting for 40% of food and drink take home expenditure and one-fifth of promoted products are purchased additionally to what would be expected without the promotion (Smithson et al. 2015). Previous research has demonstrated that retail promotions have a greater influence on purchases made on less healthy products compared to healthy foods. To date, a body of literature has examined the nature of supermarket promotion, some studies have linked it to the influence on the healthiness of purchases (Nakamura et al. 2015; Powell et al. 2016; Bogomolova et al. 2017). However, this study includes a differentiation across promotion types and also in more detail the healthiness of products to fully investigate the impact of promotional purchases across healthiness to find out whether retail promotions can improve diets.

This chapter helps fill in gaps in the literature and thereby makes three distinct contributions to the body of knowledge. Firstly, including retail promotion types by running a fractional multinomial logit model looks the probability of selling a product under a certain promotion type (price and volume promotion) compared to no promotion. In addition to contributing to the supermarket promotion literature, this study advances through using a novel method of non-linear analysis, which is using a fractional multinomial logit model. Secondly, assessing the healthiness of each product and therefore be able to split the dataset in healthy and less healthy but still takes into account the degree of healthiness of each product. Thirdly, the role across promotion types will be assessed by the brand status of a product (branded or private label). Therefore, the first analysis chapter contributes to a debate on role of retailers in shaping the diet of consumers through the use of promotional activities in the retail environment assessing several product characteristics.

This empirical chapter focusses on the product-level analysis investigating the influence of promotion on the healthiness of products sold, highlighting the view from the supply side and the strategy to put that particular product under a promotional offer and will try to investigate both sides – the product-level analysis from the retailer side looking at the application of promotions and in the second empirical chapter application at the household-level data linking socio-economic characteristics of the households to aggregated products purchased. Table 4.1 highlights the gap in the current state of the literature (only peer-reviewed journals and not including government reports) looking only at product-level analysis describing the supply/retailer side of the application of promotions.

Table 4.1 Studies examining the supply side of retail promotion.

Author	**Investigated category**	**Analysis**	**Data**	**Promotion type**	**Variables used**
Nakamura et al. (2014)	Alcoholic beverages	Difference-in-differences analysis	Kantar household panel data (2010)	Pre- and post-Multi-buy ban	SES
Bogomolova et al. (2015)	Supermarket purchases (16 cat. US & 20 cat. UK)	Descriptive Statistics and Regression	US 'strip' data (2008-2010) & UK household panel data (2005-2012)	Across promotion types	Depth of discount Brand types
Nakamura et al. (2015)	Food (135 categories)	Hierarchical regression	Kantar household panel of purchase data (2010)	On / Off promotion	Product categories, UK FSA, SES
Powell et al. (2016)	Food and beverages (44 items)	OLS regression / multivariable logistic regression	In-store retail data (cross section) Supermarket shelf prices (2010-2012)	Price promotion only	Healthiness, Store type, SES, Product size
Riesenberg et al. (2019)	1579 Food products in 11 categories	Descriptive and t-test and variance	Retailer online price data (cross section) (April 2017-April 2018)	No price and volume differentiation	HSR, Health classification
This study	**Breakfast cereals**	**Fractional multinomial logit**	**Kantar Worldpanel (2015)**	**Price and volume promotion**	**SES, SIMD, Healthiness, Brand status**

Despite the extensive number of empirical studies dedicated to assessing the influence of promotions on purchase and consumption behaviour, the literature remains inconsistent and inconclusive. In fact, five limitations are identified and subsequently addressed in this empirical chapter.

First, most empirical studies investigating the role of promotions and the influence on purchases adopt a narrow approach testing the direct link between sales volume and consumption behaviour. The literature on promotion is lacking a comprehensive approach including the use and the interpretation of the data, especially differentiating between purchase and consumption data. Studies make use of retail data (Powell et al. 2016, Riesenberg et al. 2019), household purchase data (Bogomolova et al. 2015, Nakamura et al. 2015) but also observation data of weekly promotional flyers (Ravensbergen et al. 2015), which makes studies difficult to compare. Therefore, this thesis uses household purchase data to look at the retailer perspective (product-level data) and consumer side (household-level data).

Second, most studies analyse retail promotions include only one type of promotion (Powell et al. 2016) or just on off promotion (Nakamura et al. 2015; Revoredo-Giha et al. 2018), thus neglecting the other promotion types all having a distinct impact on the retailer and consumers. The majority of research studies that examine the retail promotions and their influence on products sold and purchased

have overlooked the effects across different promotion types. Bogomolova et al. (2015) urge for the need to include promotion types as it is "potentially a significant source of variance in sales that has not yet been taken into account". This may have the effect of being erroneously attributed to other variables that correlate with a certain promotion type. Kaur et al. (2020) mention the lack of data in the existing literature that does not allow for distinguishing between price and volume promotions. Therefore, this study takes into account different promotion types investigating their distinct effect.

Third, the empirical literature looking at the influence of promotions across healthiness has been restricted to several models all defining healthiness in a different way. One way to define the healthiness is a food category approach looking at the average health of a category instead of examining each product. For this reason, this study includes the often-validated UK FSA Nutrient Profiling Score for each product in the dataset but also run the analysis when splitting the dataset by healthy and less healthy products. Revoredo-Giha et al. (2018) mentions in their research limitations the need for separating healthy and less healthy products of the same category in future analysis.

Fourth, the number of promotion studies conducted around the world (such as US and NZ) outnumbers by far the number of studies dealing with the United Kingdom; hence the role of promotion for a retail environment in the UK with a high use of promotions and a market full of private label products shall be included in further research and therefore this study focuses on Scotland – the part of the UK with the highest obesity rates. Finally, most previous studies lack a variety of analysis. Most studies use a regression (such as OLS, hierarchical) or descriptive statistics only as underlined in Table 4.1. Therefore, this empirical chapter uses a non-linear fractional multinomial logit model to support current models provides evidence on the applicability.

Overall, only few studies have quantified how promoted purchases differ by food healthiness, or by socio-economic status of the consumers. Evidence to date on the prevalence of supermarket promotions among retail purchases is limited to a few countries giving only very country and context-specific information. Moreover, evidence is also lacking including the private label products that are purchased across socio-economic characteristics of household under promotion. Zorbas et al. (2020) call for a better understand of private label product purchases in order to gain a better understanding of retail pricing strategies. Therefore, this study aims to estimate the probability that products are purchased under specific promotion types across health and brand status for a representative sample of Scottish households. Furthermore, this empirical chapter intents to clarify whether the products sold differ across SES. In order to inform effective population food policies and deliver context-specific evidence on how promoted purchases vary across healthy and less healthy products and across branded and private label products and whether this differs across specific household characteristics.

4.3.5. Research questions and aim

In order to investigate the role of retail promotions to encourage healthier diets, the analysis needs to include the difference in promotional activity between the health status and brand status especially with the given evidence that a defining characteristic of the United Kingdom FMCG market is the dominance of private label products. The focus of this research question is the effect of certain product characteristics on the probability that a product has been promoted by a supermarket as well as has been bought by the consumers, and therefore appeared in the panel dataset as a purchase. The likelihood of a product to be promoted under price or volume promotion will be analysed based on various characteristics, across the whole breakfast cereal category in the first analysis, but also separated by health and brand status.

RQ1: What type of breakfast cereal products are more likely to be promoted in a supermarket?

Specifically,

a. Are less healthy breakfast cereals more likely to be promoted than healthier ones?

b. Are branded breakfast cereals more likely to be promoted than private label ones?

The purpose of the following research question is to identify the factors that affect selling products under promotions from a supply side orientation. The factors are defined as product, household and shop characteristics and their effect on the likelihood to sell a product under a certain promotion type is analysed. The research question will be addressed through a fractional multinomial logit model run on product-level data. Three separate models will be analysed across the full breakfast cereal category, but also distinguishing healthy and less healthy breakfast cereal products as well as branded and private label breakfast cereal products. Overall, the model analyses the probability of a product to be purchased under a particular promotion type affected by characteristics of the product, shop and household and the quantity for each product under a promotion was aggregated over weeks and over households.

The broader aim is to give practical implications to influence healthier eating habits especially with regards to the socio-economic background of the consumers in order to introduce a healthier diet through promotional retail strategies among the poorest household when examining how supermarkets target consumers and how they respond. The motivation behind this research question is gaining knowledge how retailers and consumers are influenced by supermarket promotions, and therefore giving potential to improve the diet of the population because the majority of food is purchased in supermarkets. Investigating how to target consumers across different socio-economic groups through retail promotions can be an opportunity to change the diet when promoting the right products at the right moment with the right strategy that appeals to the targeted consumer.

This empirical chapter contributes to the topic of retail promotions by (i) providing insights to bar-code specific data of a Scottish consumer panel; (ii) differentiating between supermarket promotion

types; (iii) employing the UK FSA score to investigate the health status of each product within the breakfast cereal category; (iv) running the analysis on a split dataset by health and brand status; (v) and applying a non-linear fractional multinomial logit model.

The novel feature of this chapter is the perspective of looking at consumer data from a retailer side. This is possible because the products that are purchased by the consumer have been offered under a promotion by the retailer in the first place. However, it has to be acknowledged that is not only a retailer perspective because the products need to be purchased by the households to be recorded in the dataset and therefore this chapter offers a description of the supply side through consumer data. This analysis can be seen as a window into the retailer's promotional strategies through the behaviour of consumers and this approach using a consumer dataset to inform about retailer behaviour is an innovative way. It can be argued that a majority of products offered are not mentioned in the dataset because they have not been bought but evidence shows that only a small percentage of products has not been purchased knowing that retailers always try to maximise their outreach and profit through having the most successful strategies on their shelves. Therefore, this first chapter looks at the effects of retailers through the lens of a consumer purchase behaviour, whereas the second and third chapter will look at the purchases made by the households.

Although supermarket promotions have been mentioned in consumer research and around food policy studies, the influence of promotions on the healthiness of the food consumption has not been sufficiently explored. This study uses the fractional multinomial logit model to distinguish between different promotion types and seeks to fill the gap by examining the influence across promotion types on the Scottish diet. The analysis of this study adds to the existing literature by identifying characteristics of the products, shops and the consumers that affect products sold under different promotion types. However, this study also identifies characteristics like a product-specific degree of healthiness and the role of the brand that were not emphasised in the existing literature. Another contribution to the research analysis compared to the literature is the definition of the dependent variable. Other studies have used as a dependent variable the sales quantity of products sold and included the promotion aspect as an independent variable and often the promotion variable has not been distinguished by promotion type and focussed on on/off promotion and price promotion only ((Ball et al. 2015; Bogomolova et al. 2015; Nakamura et al. 2015).

4.3. Method and data description

The following sections of this empirical chapter provide a description of the method used to analyse the data, an explanation of the measurement variables and follow by a description of the data set relevant for this research question. Attention will be focused on the research method and the reason for the choice of type of analysis will be justified.

Due to the common belief that the poorest buy the unhealthiest food under promotion, it seems relevant to investigate whether or not the retail promotions play a crucial part in the obesity crisis of Scotland. This research examines the impact of retail promotions on the diet and shed a light on the factors that influence the probability of a breakfast cereal product has been sold under different promotion types in the supermarket in Scotland. To this aim, a fractional multinomial logit model is adopted. What are the factors that influence the probability of a product being sold under various promotion types? To address this question, the probability of a product to be sold under a particular promotion is analysed in relation to various characteristics of the product. The quantity for each product bought under a promotion is aggregated over weeks and households and the proportion of purchases is measured across three different promotion types: no promotion, price promotion and volume promotion. Because the independent variables are various product characteristics and the dependent variable is expressed in terms of three outcomes (being bought under no promotion, price promotion or volume promotion), the fractional multinomial logit model is suitable for this analysis.

4.3.1. Fractional multinomial logit

This study uses a fractional multinomial logit model, which is an extension of the multinomial logit model. Both models assume predicted values as a result, which are probabilities in multinomial logit and proportions in fractional multinomial logit, depending on the explanatory variables. Papke and Wooldridge first proposed this method in 1996 to model fractional response variables ranging from 0 to 1, which is similar to a multinomial fractional model but in the fractional multinomial logit is a proportion or fraction is used, which adds up to 1. The basic binary logistic regression has various extensions when the dependent variable has more than two levels. If there exist more than two categories and when the dependent variables imply a categorical output, then multinomial logistic regression is used (Cameron and Trivedi 2005). Multinomial logit models can have the outcomes $1, 2, 3, \ldots, m$ recorded in the dependent variable y, and the explanatory variables X. Assuming that there are three outcomes ($m = 3$) and the values of y are unordered categorical outcomes.

For the (e.g. three-category) multinomial logit model, consider a set of coefficients for each outcome ($\beta^{(1)}, \beta^{(2)}, \beta^{(3)}$) is estimated:

$$\Pr(y = 1) = \frac{e^{X\beta^{(1)}}}{e^{X\beta^{(1)}} + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \quad (4.1)$$

$$\Pr(y = 2) = \frac{e^{X\beta^{(2)}}}{e^{X\beta^{(1)}} + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \quad (4.2)$$

$$\Pr(y = 3) = \frac{e^{X\beta^{(3)}}}{e^{X\beta^{(1)}} + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \quad (4.3)$$

However, there is more than one solution to $\beta^{(1)}, \beta^{(2)}, \beta^{(3)}$ which can lead to the same probabilities for $y = 1,\ y = 2,\ y = 3$, so when setting one coefficient to zero the remaining two measure the change relative to the base group or reference category. For example, setting $\beta^{(1)} = 0$, then $\beta^{(2)}\ and\ \beta^{(3)}$ measure the change relative to the base group $y = 1$. The coefficient will differ depending on the chosen base category that was set to 0. However, the predicted probabilities will be the same.

$$\Pr(y = 1) = \frac{1}{1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \tag{4.4}$$

$$\Pr(y = 2) = \frac{e^{X\beta^{(2)}}}{1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \tag{4.5}$$

$$\Pr(y = 3) = \frac{e^{X\beta^{(3)}}}{1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \tag{4.6}$$

The relative probability of $y = 2$ compared to the base group is

$$\frac{\Pr\,(y=2)}{\Pr\,(y=1)} = e^{X\beta^{(2)}} \tag{4.7}$$

Therefore, the multinomial logit model specifies

$$Pr(Y_i = j \mid x_i) = p_{ij} \tag{4.8}$$

Showing the probability that the individual i chooses alternative j, given the characteristics x_i and there are m probabilities.

$$p_{ij} = \frac{e^{x_i'\beta_j}}{\sum_{r=1}^{m} e^{x_i'\beta_r}} \quad j = 1, \ldots, J. \tag{4.9}$$

Because $\sum_{r=1}^{m} Pij = 1$, a restriction is given, which is $\beta_1 = 0$. This normalisation is called base category, which is the reference point for the other alternatives.

The exponential function gives all probabilities greater than zero and the probabilities have the requirement to be less than one and across all categories can be added up to unity. The model has m parameter vectors $(\beta_1, \ldots, \beta_J)$. The outcome-specific parameter vectors β_j allow that the change in a regressor can be different for each outcome probability.

In this study the data will be estimated in Stata using the fmlogit function and it examines the shift between the different categories of the dependent variable. Instead of having separate dependent variables, in the fractional multinomial logit the dependent variables add up to 1 as they are proportions of the overall dependent variable. Also normalising one set of parameters, as in the multinomial logit model, is required in the fractional multinomial model as well. In other words,

$$G_j(x_i\beta) = \frac{1}{1+\sum_{r=1}^{m-1} e^{x_i'\beta_r}} \quad (4.10)$$

and

$$G_j(x_i\beta) = \frac{e^{x_i'\beta_j}}{1+\sum_{r=1}^{m-1} e^{x_i'\beta_r}} \quad (4.11)$$

Advantages of using the multinomial logit model are for example the ease of expressing the probability of choosing a given alternative and a likelihood function that can be formed and maximised. However, a limitation of the model is the Independence of Irrelevant Alternatives (IIA). The multinomial logit model is only valid under the assumption of the IIA, which is established when two or more alternatives in the dependent variable are not close substitutes. The IIA assumption is tested by the Hausman test, which was developed by Hausman and McFadden in 1984 and evaluates the statistical data on whether the model fits the dataset and if the alternatives are independent from each other. If an alternative is irrelevant then it means that an exclusion of that alternative should not change the estimation of the parameters (Winkelmann and Boes 2009; Koch 2010).

It is misleading to assume that β_j is associated with $j-th$ outcome. Due to the nonlinear form, the parameters do not measure the direct effect of the independent variable on the outcome probability. Note, that the coefficients in a multinomial logit always have to be interpreted in relation to the reference category (Cameron and Trivedi 2005; Greene 2018). The coefficients from the fractional multinomial logit are interpreted like a multinomial logit and also compares interpretations to the reference category (Healy 2014, Frogner et al. 2017). The multinomial logit model calculates the changes in the log of the odds of the dependent variable. For example, in the current analysis the log of the odds gives the relation of for example price promotion over no promotion. A positive coefficient implies increased odds for choosing an alternative over the base category, holding all other regressors constant. A negative coefficient suggests the odds in favour of no promotion are greater than price promotion (Gujarati 2014).

The interpretation of the ratios in a fractional multinomial logistic regression should be compared to 1. Ratios less than 1 imply relatively less purchases on price promotion (or volume promotion) relative to no promotion for the variable of interest (e.g., rural vs urban). Ratios greater than 1 imply that relatively more purchases (e.g., all females vs males). Ratios equal to 1 mean that the categories of the variables of interest show no difference in the purchase patterns between the categories (e.g. relative purchases made under price promotion compared to no promotion is the same for the females vs the males). The literature has underlined the difficulty interpreting the estimated multinomial logit coefficients. In the literature, studies have analysed fractional multinomial logit results in various ways: Using the coefficients as being odds ratios (Khang et al. 2015), average partial effects (Koch 2015), log-ratios have been converted to ratios (Healy 2014) and marginal effects and average marginal

effects as well as average elasticities (Frogner et al. 2017). In this study, the fractional multinomial logit will be estimated using average marginal effects which are discussed in the following section.

Marginal effects and average marginal effects

A possibility of interpreting the results is through marginal effects, which indicate the impact on a unit change in the value of the regressor on the chosen probability and the following analysis will make use of the interpretation of the estimated coefficients through average marginal effects. The use of marginal effects is a way of presenting results as differences in probabilities, which is more informative than odds ratios and relative risks that cannot offer a sense of magnitude. According to Gujarati (2014), marginal impact of X on the probability might have different signs than the coefficient of X, which happens because all parameters are included in the computation of the marginal impact of X on the probability and not just the coefficients of X. However, it is difficult to interpret these predicted probabilities because they do not increase constantly for each unit increase in the independent variable. As a matter of fact, the effect of the explanatory variables is stronger when reaching 50% of the predicted probabilities and weaker when approaching 0% or 100%.

Compared to *margins at means* approach, which uses the mean values to compute predicted probabilities when computing the marginal effects for a variable and reports the average of the mean values, the average marginal effects approach is preferred in the literature (Gujarati 2014). To get the average marginal effect (AME), the marginal effect is first calculated for each individual with their observed levels of covariates and then these values are averaged across all individuals. Therefore, using the *average marginal effects* in this study is a suitable option. It is recommended that average marginal effects should be used for multinomial logit models or the conditional effects plot, to avoid misinterpreting the coefficients. It is the most common way when using marginal effects is the average values of the explanatory variables. Marginal effects are used as a measure of the probabilities of a change in the regressors and elasticities can be calculated by multiplying the marginal effects of the regressor and then dividing it by the probability, which then can be averaged over individuals to show average elasticities or average marginal effects. Changes in probabilities sum up to zero for marginal effects, so for example an increase in an explanatory variable will increase the probability in some categories while reducing it in others. The average marginal response of the probability of choosing each alternative when a regressor changes for one of the alternatives and is unchanged for the other alternatives (Cameron and Trivedi 2005; Frogner et al. 2017).

Based on Winkelmann and Boes (2009), the marginal change in the probability and can be shown algebraically as the marginal probability effect (MPE):

$$MPE_{i1l} = \frac{\partial p_{i1}}{\partial p_{il}} = -p_{i1} \sum_{r=2}^{m} p_{ir}\beta_{rl} \tag{4.12}$$

$$MPE_{ijl} = \frac{\partial p_{i1}}{\partial p_{il}} = p_{i1}\left[\beta_{jl} - \sum_{r=2}^{m} p_{ir}\beta_{rl}\right] \tag{4.13}$$

$$j = 2, \dots, m$$

where MPE_{ijl} is the marginal probability effect (MPE) for i choosing an alternative j if the $l-th$ element in x_i increases by a small unit. This shows that the marginal probability effect depends on the probabilities and parameters of all the other outcomes and therefore a positive β_{jl} does not mean that MPE might be positive. The average of the partial effect of X on y is the average partial effect (APE), or the average marginal effect (AME). Average marginal effects (Average marginal probability effect (AMPE)) is the average of all marginal effects of the covariate patterns.

$$\widehat{AMPE}_{jl} = \frac{1}{n} \sum_{i=1}^{n} \widehat{MPE}_{ijl} \qquad j = 1, \dots, m \tag{4.14}$$

Note, that it is important to differentiate between marginal effect at the mean (MEM) and the average marginal effect (AME). A marginal effect at a point (for example the mean) is an estimate of the marginal effect at chosen covariate values, and an average marginal effect is an estimate of a population-averaged marginal effect. Partial effects sum to zero because the effect of a change in any variable results in a different substitution pattern between the alternatives (Koch 2015).

4.3.2. Model specification

To address the research question and objectives of this empirical chapter, which is to analyse the probability of a product to be sold under a particular promotion in relation to various characteristics of the product. The quantity for each product bought under a promotion is aggregated over weeks and households and the proportion of purchases is measured across three different promotion types: no promotion, price promotion and volume promotion. Because the independent variables are various product characteristics and the dependent variable is expressed in terms of three outcomes (being bought under no promotion, price promotion or volume promotion), the fractional multinomial logit model is suitable for this analysis. Other motivations for the choice of this model are listed as below.

First, multinomial logit is applicable because it is used for unordered and fractional categories and in this study the dependent variable is expressed as proportions. All purchases equal 100% and the proportions consist of all products sold various times across all three promotion types, which add up to

1 (or 100%). Due to the fact that a product has been sold over a year in all three categories, meaning a specific product has been bought under no promotion and price promotion and volume promotion across 52 weeks. Expressing this into proportions in the fractional multinomial logit is a useful technique as products are not just classified into one single category but rather across all three. Further, the proportion includes also the frequency of purchases which therefore impacts the weight of the proportion. Another reason for using a fractional multinomial logit model is the novelty of the method in the recent literature. Studies in this research area have mainly used multiple linear regression models and ordinary least squares regressions (Bogomolova et al. 2015; Nakamura et al. 2015; Powell et al. 2016). Powell et al. (2016) employ a multivariable logistic regression as a pre-analysis in their study however, the main method is OLS regression. The application of the fractional multinomial logit model in this study underlines the novelty from an analytic point of view for several reasons. Using a non-linear model is rare and adds another viewpoint to the frequently used linear models since a linear regression could not have given the same detail of analysis. Moreover, this study utilises retail promotions as a dependent variable, which is divided into different promotion types to be able to examine the factors that influence the purchases made under each promotional type. As mentioned above, including the promotion types as a dependent variable is a new contribution to knowledge as it is usually treated as an independent variable in the earlier literature (Ball et al. 2015, Bogomolova et al. 2015, Nakamura et al. 2015, Smith et al. 2017). Not only do promotions act as the dependent variable, but they can also be distinguished by promotion type as the fractional multinomial logit model allows to have two or more outcomes of the dependent variable. Thus, to the aim of analysing product and shop characteristics as well as the socio-economic background of the consumers that influence the proportion of the purchases made under promotion, the fractional multinomial logit model is the excellent fit for this analysis.

To recap, a multinomial logit model can be represented by the different outcomes $1, 2, 3, \ldots, m$ recorded in the dependent variable Y_i, and the explanatory variables X. Assuming that Y_i may take one of three outcomes ($m = 3$): "no promotion", "price promotion", and "volume promotion". The values of Y_i are unordered categorical outcomes and are given in proportions that add up to 1. Specifically, the fractional multinomial logit model is specified as:

$$\Pr\{Y_i = PT\} = g\left(\beta_0 + \sum_{i=1}^{m} P_i + \sum_{i=1}^{n} S_i + \sum_{i=1}^{o} Z_i\right) \tag{4.15}$$

where $\Pr\{Y_i = PT\}$ denotes the probability that the *i*-th purchase falls in the *PT*-th category (no promotion, price promotion, and volume promotion), g(·) is the logistic function, β_0 is the constant; P_i represent all the product characteristics of the product *i*; $S_i$the weighted socio-economic background of the consumers; Z_i the weighted shop characteristics of the purchased products.

In this study, the dependent variable is a proportion of the purchases made under different promotion types (purchased under no promotion, purchased under price promotion and purchased under no promotion), which all add up to total purchases of 1 or 100%. This study uses the quantity of products purchased and not the expenditure as a dependent variable due to the aim to investigate promotion types including volume promotions which include the quantity of products and not simply the value in pounds. Due to the nature of the dependent variable, which is the proportion of purchases made under different promotion types, the model used was a fractional multinomial logit model because it allows a fractional dependent variable (purchases made using more than two proportions) and the sum of the dependent variables is 1 (1 as the total purchases made). One variable of the dependent variable is used as the reference category (purchases made under no promotion) and all the other outcomes (purchases made under price and volume promotion) are compared to that reference category. Independent variables are categorised into three categories; product characteristics, shop characteristics and the household characteristics. Product characteristics include for example the size of the product in terms of weight, the healthiness of the product as well as the price of the product. Independent variables on household characteristics included are for example age, the location of the household (rural vs urban), the gender of the principal shopper (female vs male), household composition such as living as a single or in an extended family/ multiple adult household as well as the deprivation level of the household (Scottish Index for Multiple Deprivation). One key interest is the level of deprivation of the household in the study, although average annual income has been introduced as well in the model, partially as a robustness check and to ascertain whether there are any differences on the dependent variable.

The fractional multinomial logit model applied on the product-level dataset will provide answers to the question of the influence of the independent variables (product characteristics, shop characteristics and socio-demographic characteristics of the household) on the likelihood of choosing an option of the dependent variables (price or volume promotion) compared to the reference category (no promotion). It only explains the relationship between one option compared to the reference category, however, it does not give any details on how the relationship looks like. The aim of using this model is to be able to compare different supermarket promotion types according to their frequency of purchases across one year.

The variables are calculated as aggregated proportions over a year collapsed by product level across Scotland. It indicates that the interpretation of product characteristics has not changed across the year and is not aggregated or weighted. However, the household and shop characteristics are aggregated and weighted averages over the year due to the fact that the data was collapsed by products. Weighted average is a calculation that considers the varying degrees of importance of the numbers in the given data set based on the frequency purchased. Each number in the data set is multiplied by a predetermined weight (in this study a weighted household and weighted shop factor) before the final calculation is made. In doing this, the weighted average is more accurate than a simple average in which all numbers

in a data set are given the same weight before summing them to a sole average value through the use of frequency.

4.3.3. Data description of products

This study adopts the use of descriptive statistics, propensity score matching and fractional multinomial logit analysis to quest the answer to the first research question. Exploring the descriptive statistics helps to analyse the data from a preliminary viewpoint. The first research question deals with product characteristics that influence the probability of a product to be sold under different promotion types in the supermarket. This chapter examines the relationship of the variables in the econometric model as specified in the preceding chapters. First of all, the chapter presents the descriptive statistics of the variables used in the model. Afterwards, the results of the fractional multinomial logit model will be discussed. Drawing from an econometric viewpoint, the following results are analysing factors that influence the probability of a product to be sold under promotion in the supermarket.

To recap, the construction of the collapsed dataset has been described in chapter 3.2. and this has been used in the final analysis of this empirical chapter. It includes 1,122 breakfast cereal products that have been purchased in 2015 with information on product characteristics, weighted shop information as well as weighted socio-economic characteristics of the household. Therefore, the unit of analysis is product-level data that has been aggregated across all weeks in the year 2015. Moreover, the product-level analysis needed to aggregate the household information as well as shop information, which indicates that each product has an average household and shop characteristics based on all purchases made of that product in the whole year. This limitation needs to be mentioned up front as the analysis will only give average information of the households and shops per product. Therefore, the independent variables are the product characteristics, the average weighted household and the average weighted shop characteristics. The dependent variable is the proportion of the i-th product bought under three promotion types (no promotion, price promotion and volume promotion). In this study, the cross-section data for the year 2015 used the Propensity Score Matching to decrease the amount of missing values of the household characteristic on the income and the deprivation level. The information given in the Scottish Household Survey 2015 was matched with the household information in the Kantar dataset to match the missing information with that of similar households. The different characteristics of all variables being employed are displayed in the choice of variables (Table 4.2).

Table 4.2 Description of the variables employed in the analysis.

Variables	Measures/ Description
Dependent variables	
No promotion	Purchases made under no promotion
Price promotion	Purchases made under price reduction promotion
Volume promotion	Purchases made under "multi-buy" and "x for £y" promotion
Product characteristics	
Full price	Logarithm of the average full price of the product i of all weekly prices in 2015 in GBP
Promotion discount	The percentage of saving through the promotional discount (expressed as a percentage reduction off the regular price per pack)
Weight	Logarithm of product package in kg
Subcategories of breakfast cereals	Dummy variable: 1 = Ready-To-Eat-Cereal; 0 otherwise Dummy variable: 1 = Instant Porridge; 0 otherwise Dummy variable: 1 = Porridge Oats; 0 otherwise Dummy variable: 1 = Muesli; 0 otherwise Dummy variable: 1 = Granola; 0 otherwise
UK FSA Score	Health score of the product (-13 to +6)
FSA Healthy	Dummy variable: 1 = Healthy; 0 otherwise
Branded label	Dummy variable: 1 = Branded; 0 otherwise
Socio-economic household characteristics	
Age	Weighted age of the principal shopper
Gender	Weighted gender of the principal shopper Dummy variable:1 = female; 0 otherwise
Number of children	Weighted number of children in the family
Annual income	Logarithm of average income of the principal shopper (weighted)
Scottish Index of Multiple Deprivation (SIMD)	Dummy variable: 1 = SIMD 1 (most deprived); 0 otherwise Dummy variable: 1 = SIMD 2; 0 otherwise Dummy variable: 1 = SIMD 3; 0 otherwise Dummy variable: 1 = SIMD 4; 0 otherwise Dummy variable: 1 = SIMD 5 (least deprived); 0 otherwise
Rural accessibility	Dummy variable: 1 = Rural; 0 otherwise
Shop characteristics	
Online purchase	Dummy variable: 1 = Online; 0 otherwise
Supermarket types	Dummy variable: 1 = Major supermarket brands; 0 otherwise Dummy variable: 1 = Convenience formats of main retailers; 0 otherwise Dummy variable: 1 = Internet retailers; 0 otherwise Dummy variable: 1 = Internet general; 0 otherwise Dummy variable: 1 = Discount supermarkets; 0 otherwise Dummy variable: 1 = Corner shops and other local shops; 0 otherwise Dummy variable: 1 = Other shops 0 otherwise

Table 4.3. below describes the first three variables representing the dependent variable is this analysis. The proportion of purchases made in the breakfast cereal category are divided into three groups: purchased under no promotion, purchased under price promotion and purchased under volume promotion. The majority of products are purchased under no promotion, followed by price promotion and volume promotion, having a mean proportion across all purchases of 0.747 for no promotion, 0.195 for price promotion and 0.058 for volume promotion. The product characteristics can be interpreted normally and show for instance that the mean full price for 100g of breakfast cereal is £0.53, the weight of a product is on average 0.499 kg - the smallest package sold is 22g and the largest 3 kg. Another important variable is the average price discount of 7.6% and the health score of the products shows that the minimum value is -6 which is considered *healthy* and a maximum of 13, which is considered *less healthy* based on the UK FSA nutrient profiling. The label characteristics show that branded national labels compared to private labels are more than half of the purchased products (53.1%).

Table 4.3 Collapsed product level dataset description across the whole breakfast cereal dataset.

	Mean	**SD**	**Min**	**Max**
Proportion of products purchased under *no promotion*	0.747	0.315	0	1
Proportion of products purchased under *price promotion*	0.195	0.283	0	1
Proportion of products purchased under *volume promotion*	0.058	0.149	0	1
Product characteristics				
Full price per 100g	0.531	0.452	0.05	4.363
Full price per 100g (log)	-0.876	0.672	-2.995	1.473
Weight (in g)	499	289	22	3000
Price discount (in %)	0.076	0.110	0	0.584
UK FSA Score	-0.036	3.868	-6	13
Branded label	0.531	0.499	0	1
Socio-economic household characteristics (all weighted):				
Age of principal shopper	47.422	8.862	8.333	89
Number of children	0.681	0.586	0	5
Female principal shopper	0.752	0.240	0	1
SIMD 1 (most deprived)	0.145	0.190	0	1
Average annual income	31.108	10.017	3.75	70
Rural accessibility	0.232	0.233	0	1
Shop characteristics (all weighted):				
Major supermarkets	0.565	0.399	0	1
Convenience format	0.075	0.156	0	1
Discounter	0.225	0.391	0	1
Note: The mean values are calculated including zero values.				

Referring to Table 4.3. the average household characteristics and the shop category need to be explained further as they deal with the collapsed dataset. Instead of using a simple average, weighted averages are used. Weighted average is a calculation that considers the varying degrees of importance of the numbers in the given data set. Each number in the data set is multiplied by a predetermined weight (in this study a weighted household and weighted shop factor) before the final calculation is made. In doing this, the weighted average is more accurate than a simple average in which all numbers in a data set are given the same weight before summing them to a sole average value. Therefore, the shop characteristics dealing with the location of the purchase is shown as a weighted variable due to the fact that the data was collapsed by products. In this case the shops where the products have been purchased across the year are included through using the frequency, giving more importance to the shops where products have been purchased most. The same has been done for household characteristics stressing the importance to the more frequent household characteristics that purchased that specific product. The weighted household characteristics are the age and gender of the principal shopper, the number of children living in the household, as well as the deprivation level and the accessibility of the household and average annual income. The weighted household characteristics show that the average age is 47, the average weighted number of children is 0.68 and 75% of the principal shoppers are female. Shop categories are also weighted and show that products are bought on average 57% in supermarkets, 7% in convenience stores and 23% in discounters.

Table 4.4 shows the mean across key product characteristics as well as the proportions of products purchased under each promotion type; no promotion, on-promotion, price promotion and volume promotion. It is shown for the whole breakfast cereal category and divided by health and brand status of the products, which will be analysed in the final fractional multinomial logit analysis. It underlines that the whole breakfast cereal category does not reflect the differences that can be seen when splitting the category by healthy and less healthy products as well as branded and private labels and stressed the need for separating the datasets also in the analysis. Comparing the proportions of products sold under each promotion type is used to get a descriptive overview of the dependent variables used in the analysis.

Table 4.4 Mean of the collapsed product level dataset description across health and brand status.

	All products	**Healthy products**	**Less healthy products**	**Branded products**	**Private products**
Products:	**1,122**	**913 (81%)**	**209 (19%)**	**596 (53%)**	**526 (47%)**
Proportion no promotion	0.747	0.755	0.712	0.670	0.833
Proportion on promotion	0.253	0.245	0.288	0.330	0.167
Proportion price promotion	0.195	0.186	0.234	0.245	0.139
Proportion volume promotion	0.058	0.059	0.054	0.085	0.028
Full price (per 100g)	0.531	0.537	0.505	0.675	0.367
Promotional price (per 100g)	0.469	0.474	0.448	0.587	0.335
Promotional depth (in %)	0.076	0.073	0.089	0.105	0.043
Depth without zeros (in %)	0.149	0.146	0.159	0.165	0.117
UK FSA Score	-0.036	-1.42	6.047	0.092	-0.182
Branded label (prop. in %)	0.531	0.524	0.559	1	0
Weight in g	499.11	503.23	481.11	443	562

With regard to products sold under no promotion, branded products have the smallest proportion (67 %) of purchases under no promotion and private labels the largest proportion under no promotion (83 %), whereas the average across the whole category is around 75 %. Comparing this to purchases made under any promotion regardless of promotion type, the differences are seen between healthy and less healthy as well as branded and private labels. It motivates to also split the data set across healthiness because the less healthy products are promoted more under promotion in general. Splitting the data into price and volume promotion gives more insights on how promotions affect healthy and less healthy products sold. The same is applicable for an even larger proportion of purchases under promotion for branded products (33%). Knowing that branded and less healthy products have the highest proportion on purchases made under promotion in general underlines the motivation to split the promotion variable into price and volume promotion but also splitting the data set into two categories by brand and health status in the analysis.

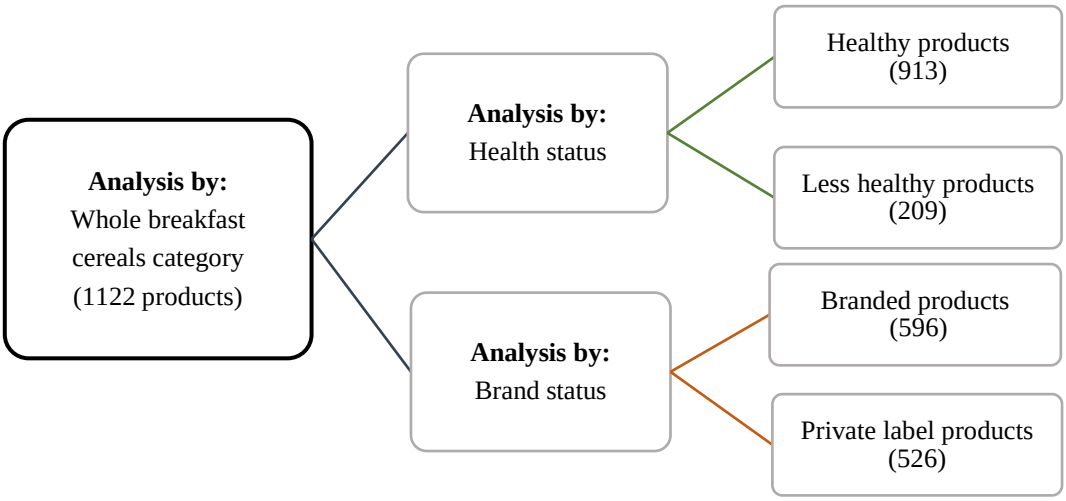
Considering the promotion types, across the whole breakfast cereal category, the price promotion proportion exceeds the volume promotion greatly (20% compared to 6%). It can be seen that the price promotions are applied more on less healthy products (23%) and branded products (24%) compared to the average of the category. However, it has been found to be lower for healthy (19%) and private label products (14%). Volume promotion has the greatest proportion for branded products (9%)

and the lowest for private label (3%), compared to the category average of 6%, which is the same for healthy (6%) and less healthy (5%).

Comparing product characteristics from a descriptive analysis point of view, highlights the key metrics of food retailing that are used to describe the data for the research question. The full price without any applied discounts, shows that the average in the breakfast cereal category is £0.53 per 100g. Similar shelf prices are found for healthy (£0.54) and less healthy products (£0.51), however a greater difference has been found for £0.68 per 100g for a branded product compared to nearly half of the price for private label products (£0.37). Promotional price, which includes the promotional discount, shows that across the whole category £0.47 is spend per 100g. Again, a similar range has been found across healthy and less healthy (£0.47 and £0.45) but it differs between the promotional price of branded products per 100g which is £0.59 and £0.34 for private label. The difference between the two key metrics is expressed in the promotional depth. Focussing on products that are purchased under promotion, shows that across the whole category the average discount was 15%, compared to healthy (15%) and less healthy (16%) and 17% for branded and 12% for private label. The main product characteristics and key interests of the study is the health and the brand status of a product. UK FSA Score, indicating the degree of healthiness of a product (4 or more are less healthy), the average across the whole category is -0 representing a "healthy" average. The branded products have a score of 0.1 compared to -0.2, which are both classified as healthy but it shows that branded are slightly less healthy. Branded label proportion of the products are about 53% across all breakfast cereals and 52% of healthy products are branded and 56% of less healthy products are branded. Weight in grams across the different subsample of breakfast cereals gives insights to the size of the packages. The average sold for the whole category is 499g compared to healthier packages being slightly bigger (503g) and less healthy products smaller than the average (481g). A greater difference can be seen for branded products being 443g on average and private label products 562g, being the biggest pack of the subsamples.

All in all, the differences across subsamples are vital to explore. It justifies splitting the dataset by health and brand status because they differ greatly compared to the whole breakfast cereal category. The proportion of products purchased by price and volume promotion show that just "on promotion" purchases do not give enough insights of the implications/effects that different promotion types have. Therefore, in the analysis, promotion types are examined separately, but also the dataset is analysed by health and brand status separately. After the analysis across the whole category, the products are split by brand and health status to investigate the influence of promotion types for health and less healthy products, as well as branded and private label products. This research question investigates the role of the brand status as well as the health status of a product. Figure 4.2 underlines how the three different analysis have been set up in this empirical chapter.

Figure 4.2 Analysis structure of first empirical chapter.



4.4. Empirical Results

The aim of this research study is to identify the factors that affect selling breakfast cereal products under promotions from a retail perspective. These factors are grouped into product characteristics, socio-economic characteristics of the household and shop categories and the results examine their influence on the likelihood to sell a product under a certain promotion type. The analysis applies a fractional multinomial logit model due to the fact that the dependent variable is a fractional proportion of each products sold under three promotion types (no promotion, price promotion and volume promotion), which adds up to 1. This assesses the influence of various factors on purchases made under price and volume promotion compared to no promotion. This study gives insights to the proportion of products sold under promotion in 2015 aggregated by product level describing the retailer's supply side using household's demand side data. It is based on an average weighted proportion of household and shop characteristics and aggregated for each product.

The literature has investigated on/off promotion (e.g., Nakamura et al. 2015; Revoredo-Giha et al. 2018) and most of them mention the necessity for further research on promotion types. The literature review in Chapter 2 (Section 2.4.) explains the differences in price and volume promotion and how important it is to differentiate between price and volume promotions due to different implications for the retailers and the consumers. Retail promotions in general have an effect on purchase behaviour and increase sales but the price and volume promotion have a different impact for the retailers and the consumers. Another reason to split the dataset in the analysis is that the descriptive statistics show that volume promotions are used more frequently on less healthy products and that price differences and promotional depth differs when retailers apply both promotion types. Furthermore, several studies dealing with promotions have stated the need for future research including promotion types in studies to be able to examine the effect of retail promotions truly (Nakamura et al. 2015; Revoredo-Giha et al.

2018; Kaur et al. 2020). Due to the number of independent variables in this study, they have been categorised across three groups of parameters: product characteristics, household characteristics and shop information.

Table 4.5 Detailed parameter groups applied in the analysis.

Dependent variable	**Proportion of purchases made under price and volume promotion**
Parameter group	Included variables
Product characteristics	Full price per 100g (median) (log)
	Weight (in kg) (log)
	Discount (in %)
	UK FSA Score
	Branded label
Socio-economic household characteristics (weighted)	Age of principal shopper
	Number of children
	Female principal shopper
	SIMD 1 (most deprived)
	Average annual income (log)
	Interaction income*UK FSA
	Interaction age*UK FSA
	Interaction SIMD1*UK FSA
	Rural accessibility
Shop characteristics (weighted)	Shop category mainstream
	Shop category convenience
	Shop category discounter

The analysis focuses on the average marginal effects, which represent the predicted change in the promotion type due to a change in one of the independent variables. The fractional multinomial logit model (Equation 10) for the full Kantar dataset is estimated and the results and the estimates of average marginal effects (AME) are reported in Table 4.6. As noted by Greene (2018), the coefficients of the fractional multinomial logit model cannot be interpreted in a straightforward manner; therefore, it is necessary to compute marginal effects to provide a better understanding of the estimated coefficients. In this model, marginal effect measures the change in the probability of selling a product under price or volume promotion compared to no promotion with respect to a change in each explanatory variable.

4.4.1. Full breakfast cereal category

This section discusses the results across all breakfast cereals and the interpretation will explain the dependent variables separately by price and volume promotion. The third category of no promotion is used as a reference category and therefore cannot be interpreted because the coefficients are set to zero. The independent variables will be presented alike Table 4.5. by the parameter groups – starting with product characteristics, followed by shop characteristics and socio-economic characteristics of the

households. Only significant results will be interpreted. Table 4.6 displays the estimated coefficients of the fractional multinomial logit model and the post-estimation average marginal effects. If the signs of the coefficients and the average marginal effects (AME) are the same, no separate interpretation will be given. However, the significance has been found to be different and the interpretation will be made for both.

The following section describes the results from the estimates analysing all 1,122 products in the breakfast cereal category (Section 4.4.1), as well as separate analysis run by health (Section 4.4.2) and brand (Section 4.4.3) status of the product, across price promotions applied by the retailer. The analysis shows that certain factors increase or decrease the probability that a product is sold under price promotion. After the analysis of the whole breakfast cereal category, it describes the results from a retailer perspective of the coefficients analysing the dataset by health status as well as by brand status.

Results of calculating variables marginal effects are presented in Table 4.6. Note that the first and second column presents the probability to *purchase products under price promotion* compared to the base category *purchased under no promotion.* The third and fourth column shows the coefficients and average marginal effects for the probability *of purchasing a product under volume promotion* compared to *no promotion*. Also note that a goodness-of-fit measure like the R^2 is not reported for the fractional multinomial logit model because it has multiple dependent variables and therefore ruling out R^2as a measure of goodness of fit (Khang et al. 2015).

Table 4.6 Fractional multinomial logit coefficients and marginal effects.

	Price promotion coefficients	Average marginal effects for price promotion	Volume promotion coefficients	Average marginal effects for volume promotion
Product characteristics				
Full price (pack) (log)	0.392** (0.132)	0.030*	0.214 (0.195)	0.003
Weight (pack) (log)	0.072 (0.109)	0.021*	-0.689*** (0.143)	-0.036***
Discount (in %)	0.174*** (0.007)	0.013***	0.132*** (0.009)	0.003***
UK FSA Score	-0.015 (0.110)	-0.007	0.473*** (0.119)	0.024***
Branded label	-0.358** (0.127)	-0.041	0.425* (0.205)	0.025**
Socio-economic characteristics (all weighted)				
Age of principal shopper	-0.020* (0.010)	-0.001	-0.027* (0.011)	-0.000
Number of children	-0.199 (0.123)	-0.015	-0.097 (0.169)	0.000
Female principal shopper	0.106 (0.276)	0.017	-0.322 (0.325)	-0.017
SIMD 1	0.042 (0.330)	-0.009	0.403 (0.327)	0.018
Average annual income	-0.003 (0.006)	-0.000	-0.003 (0.007)	-0.000
Interaction income*UK FSA	0.004** (0.001)	0.000**	-0.003 (0.002)	-0.000**
Interaction age*UK FSA	-0.002 (0.002)	-0.000	-0.008*** (0.002)	-0.000**
Rural accessibility	0.064 (0.275)	0.016	-0.447 (0.369)	-0.024
Shop characteristics (all weighted)				
Shop main supermarkets	1.274*** (0.384)	0.127***	-0.120 (0.339)	-0.031
Shop convenience	1.278** (0.481)	0.129**	0.018 (0.493)	-0.025
Shop discounter	1.039** (0.400)	0.119**	-0.864 (0.498)	-0.064*
Constant term	-3.086*** (0.741)		-2.925*** (0.864)	
Observations	1,122	1,122	1,122	1,122

This table reports the results of the fractional multinomial logit estimation of purchases under promotion. The dependent variables are the proportions of purchases made under price and volume promotion to no promotion as a reference category. For the FMNL base category (no promotion) parameters set to zero, so no parameter estimates are available. Other variables are defined as in Table 2. SEs are given in parenthesis. The signs (***), (**) and (*) denote significance at 1%, 5% and 10% level respectively.

Table 4.7 shows what the theory explained in the literature; marginal effects sum to zero because a change in any variable results in a different substitution pattern. Changes in probabilities of all three dependent variables (including the reference category) sum up to zero for marginal effects, so for instance an increase (or decrease) in an explanatory variable will increase (or decrease) the probability in some categories while reducing (or increasing) it in been in others.

Table 4.7 Fmlogit post-estimation average marginal effect for promotion types.

	Average marginal effects for no promotion	Average marginal effects for price promotion	Average marginal effects for volume promotion	SUM TO ZERO
Product characteristics				
Full price (pack) (log)	-0.036**	0.030*	0.003	✓
Weight (pack) (log)	0.015	0.021*	-0.036***	✓
Discount (in %)	-0.017***	0.013***	0.003***	✓
UK FSA Score	-0.013	-0.007	0.024***	✓
Branded label	0.015	-0.041	0.025**	✓
Socio-economic characteristics (weighted)				
Age of principal shopper	0.002**	-0.001	-0.000	✓
Number of children	0.018	-0.015	0.000	✓
Female principal shopper	0.002	0.017	-0.017	✓
SIMD 1	-0.015	-0.009	0.018	✓
Average annual income	0.000	-0.000	-0.000	✓
Interaction income*UK FSA	-0.000	0.000**	-0.000**	✓
Interaction age*UK FSA	0.000*	-0.000	-0.000**	✓
Rural accessibility	0.009	0.016	-0.024	✓
Shop characteristics (weighted)				
Shop main supermarket	-0.093**	0.127***	-0.031	✓
Shop convenience	-0.103*	0.129**	-0.025	✓
Shop discounter	-0.055	0.119**	-0.064*	✓
Observations	1,122	1,122	1,122	

Price promotion results: What factors influence the probability to sell a breakfast cereal product under this promotion type?

Among all the **product characteristics** the following variables are found to increase the probability to sell a product under price promotion: (i) An increase in the full price of a breakfast cereal product (the price before the promotion is applied), increases the likelihood for any breakfast cereal product to be sold under price promotion. In other words, the more expensive a product is the more likely it is sold under price promotion. (ii) An increase in the promotional discount also increases the likelihood that a product across the full breakfast cereal category is bought under price promotion. Overall, the proportion of breakfast cereal products sold under price promotion increases with an increase in the original full price per pack and a greater promotional discount and are associated with positive and significant coefficients. All included **shop** categories, which are main supermarket chains, convenience formats and discounters (compared to online, corner and other shops), have a positive and significant impact on breakfast cereals sold under price promotion. The results reveal that an increase the probability that all breakfast cereal products are sold (i) in main supermarkets and (ii) convenience formats and (iii) discounters increase the probability to sell products under price promotion compared to no promotion.

Only one **product characteristics** decreases the probability to sell a product under price promotion: A branded label product across the whole breakfast cereal category. This can be interpreted as private label products are therefore more likely to be sold under price promotion compared to no promotion. Looking at the **socio-economic household characteristics** and the implicated relationship of decreasing the probability to sell products under price promotion, shows that one variable has a negative and significant coefficient; (i) an older average age of the principal shopper.

Volume promotion results: What factors influence the probability to sell a breakfast cereal product under this promotion type?

The first group of estimated parameters is associated with the higher probability to sell a product under volume promotion looking at various **product characteristics**: (i) A higher promotional discount increases the likelihood to sell a product under volume promotion across the full breakfast cereal category. (ii) Another relevant product factor is the degree of healthiness. The coefficient on the healthiness of a product, is significant and positive, implying that the higher the UK FSA nutrient profiling score (or equivalently the less healthy the product), the more likely a breakfast cereal product is sold under volume promotion.

One **product characteristic** is relevant when decreasing the likelihood to sell a product under volume promotion; (i) a higher package weight decreases the proportion of a breakfast cereal product to be sold under volume promotion. This implies that smaller products are more likely to be sold as a

multi-buy compared to no promotion. **Socio-economic household characteristics** play a crucial role as (i) the older the principal shopper the less likely he/she is responding to a product under volume promotion for all products.

These finding relate to the full breakfast cereal category however further results are presented in in the following section looking at the estimates for branded and private and healthy and less healthy found in Appendix B Table B1. Table 4.8 shows the direction of the significant coefficients across all three types of analysis: across all breakfast cereal product, across health status and across brand status. Health status is divided into healthy and less healthy products and brand status is divided into branded and private label products.

Table 4.8 Significant estimates across breakfast cereal products by price and volume promotion.

	All breakfast cereals		**Healthy products**		**Less healthy products**		**Branded products**		**Private products**	
	Price promotion	Volume promotion	Price promotion	Volume promotion	Price promotion	Volume promotion	Price promotion	Volume promotion	Price promotion	Volume promotion
Product characteristics										
Full price (pack) (log)	+		+		+	-	+	+		
Weight (pack) (log)		-		-				-		-
Discount (in %)	+	+	+	+	+	+	+	+	+	+
UK FSA Score		+	+			+				+
Branded label	-	+		+	-					
Socio-economic characteristics (weighted)										
Age of principal shopper	-	-			-				-	-
Number of children			-					-	-	
Female principal shopper							+			
SIMD 1 (most deprived)										+
Annual income (log)										
Rural accessibility										
Shop characteristics (weighted)										
Shop mainstream	+		+		+		+		+	-
Shop convenience	+		+		+				+	
Shop discounter	+				+				+	-

Note: + and – represent the sign of the estimated coefficients based on the result of the Table B1 in Appendix B. "+" indicates a positive association between the type of retail promotion and the independent variable, whereas "–" indicates a negative association

4.4.2. Subsample analysis across health status of products

Retailer's promotional strategies across the health status of a product

Based on the results from the analysis done on the whole breakfast cereal category and the significant UK FSA score on volume promotion, splitting the dataset into health status of the product, which is either healthy or less healthy, has been done for several theoretical reasons as well as from a data motivational point of view. Analysing the health status by healthy and less healthy products, is the main focus of interest because the aim of this research study is to investigate the importance of the degree of healthiness of the products on the promotional activities of the retailers. Through dividing the data it examines more than just the increase or decrease in the score as it did in the above-mentioned analysis including the degree of healthiness as an independent variable. It only informs whether the product becomes less healthy but not if a product is generally unhealthy or not. The UK FSA nutrient profiling score for the breakfast cereal category has a variety from -6 to 13 and the analysis shows that there is a different effect across the entire range of scores. Also, it highlights whether the retailer applies a different strategy among healthy compared to less healthy products and how the degree of healthiness within the two categorisations/ subsamples affects the promotional offers. Moreover, categorising the products into healthy and less healthy gives insights into often discussed importance among the breakfast cereals products due to the impact of sugary breakfast cereal consumption especially among children and linking unhealthy breakfast diet to the obesity crisis as policies directly target at less healthy breakfast cereal products.

Among 1,122 products considered in the dataset, the health status of a product is only significant among those being sold under volume promotion. Splitting the dataset into health products (913) and less healthy products (209) gives further insights. The dependent variable is the proportion of healthy/ less healthy products sold under each promotion type compared to no promotion.

Does the healthiness of a product affect the likelihood to promote the product?

(i) The proportion of **healthy** products sold under price promotion increases when the product is more expensive with a greater discount, and an unhealthier product, as well as purchased by families with fewer children. More healthy products are sold in main supermarkets and convenience formats under price promotion. The proportion of healthy products sold under volume promotion increases when the product is branded with a greater promotional discount and smaller packages.

(ii) The proportion of **less healthy** products sold under price promotion increases when the product is more expensive with a higher promotional discount, with a private label and purchased by households with a younger principal shopper. It is more likely that less healthy products are sold in main supermarkets, convenience formats and discounters under price promotion. The proportion of less

healthy products sold under volume promotion increases when the product is a cheaper product, with a higher discount, and the product is unhealthier among the less healthy products.

Overall, an unhealthier product is more likely to be sold under volume promotion and price promotion. The unhealthier a product is, the more likely it will be sold under price and volume promotion to the customers of the supermarket. It reveals that less healthy products in all subsamples are promoted under volume promotion, which also includes only unhealthy breakfast cereal products, and implicates that the least healthy products are sold in bulks to the consumers. Comparing price and volume promotion across healthy and less healthy breakfast cereals, shows opposite effects across certain independent variables; for the healthy products the brand status has a contrary influence and for the less healthy products a higher full price and a higher weight has an opposite influence on the proportion sold under price and volume promotion. All in all, the degree of healthiness impacts the price and volume promotion sales, especially if they are applied more to unhealthier products.

The healthiness of a product plays a key role across the influence of retail promotion fashioning the diet of consumers. Promotions are more likely to be targeted and applied to unhealthier products compared to no promotions. On the one hand, price promotions are applied to the unhealthy products among healthy products therefore are more likely to be sold the lower their degree of healthiness is. On the other hand, volume promotions are used to promote unhealthier products across all products in the breakfast cereal category. Further, they are applied to unhealthier products among the already unhealthy category, but also among private and branded products. Looking at unhealthy, branded and private products, retailers are selling the unhealthier products in bulk making consumers purchase more and consume more, which can be part of encouraging a less healthy diet in general. From a consumer perspective, unhealthy products under price promotions are preferred by them because they feel guilty when buying less healthy products as a multi-buy in bulk and prefer a price discount for less healthy products because purchasing them includes a certain feeling of guilt (Mishra and Mishra 2011). As retailers use volume promotions on unhealthier products, another possible explanation might be that consumers buy unhealthy product easier in a multi-buy because products are “free” so this psychological trick suggesting that this offer gives the consumer something for free therefore they cannot refuse. Moreover, consumers are tempted to buy the sweeter sugary products as a treat and purchase the volume promotion as an impulse purchase. Looking at the shop category, a discounter is more likely to promote less healthy products under price promotion compared to no promotion. Consumers that shop in discounters are considered price conscious and adding price promotions on less healthy products can have a strong impact fashioning the diet among price driven consumers.

4.4.3. Subsample analysis across brand status of products

Retailer's promotional strategies across the brand status of a product

Splitting the data by brand status has a theoretical and analytical motivation. This analysis across the whole breakfast cereal category has found the contrary effect of a branded compared to a private label on products sold under price and volume promotion. This gives reason to investigate the differences in depth by dividing the dataset by the brand status to examine the factors that influence the likelihood to sell a private and branded label under each promotion type. Investigating the strategies of retailers when promoting branded label products and how they responded to by consumers across a different brand status highlights whether retailers apply a different strategy for their own products compared to branded ones. Retailers have more control of the whole chain from production to price to sales for the private label products and therefore the promotional offers might be different compared to branded. Another theoretical justification for splitting the data is the horizontal and vertical competition between brands and private labels so therefore this might have an impact on promotional strategies applied by the retailer. Moreover, the literature discusses the degree of healthiness of UK private label breakfast cereal products, because private have been found less healthy. Sugar content has risen by a fifth of UK ready-to-eat breakfast cereals since 2012 with the largest spikes coming from retail own brands, finds Action on Sugar research (Darmon and Drewnowski 2008; Clarke 2019).

After looking at the whole category with 1,122 products, the brand status of a product is significant, but its impacts differ between the two promotion types. Dividing the branded products (596) and private label products (526) gives more insights. The dependent variable is the proportion of branded/ private label products sold under each promotion type compared to no promotion.

Does the brand of a product affect the likelihood to promote the product?

(i) The proportion of **branded** products sold under price promotion increases when the product is more expensive with a higher discount. Less deprived households with female principal shoppers, as well has high income households combined with unhealthier products are more likely to respond. The proportion of branded products sold under volume promotion increases when the product is more expensive with a higher discount and smaller package size. Further, families with many children are less likely to respond. (ii) The proportion of **private** label products sold under price promotion increases when the product has a higher discount is applied and younger principal shoppers with fewer children in the family are more likely to respond. The proportion of private label products sold under volume promotion increases when the product in a smaller package size, with a higher discount and less healthy. Retailers aim with a volume promotion for private label products more towards younger principal shoppers, and the most deprived SIMD households.

Overall, the brand status affects the likelihood to promote a product and it is different across promotion types. Private label products are more likely to be sold under price promotion and branded product are more likely to be sold under volume promotion. Splitting the data by branded and private label products shows that the less healthy a branded and private label product is, the more likely it is to be sold under volume promotion. Furthermore, evidence reveals that price and volume promotions exert opposite influences across branded and private label breakfast cereals. For private label products the package weight of a product has a contrary effect, as well as the number of children and the interaction term of UK FSA and the income. Interestingly, the results show contrary effects for branded and private products across the same promotion type; for volume promotion the number of children decreases the proportion of branded products to be sold under volume promotion, but increases for private label products. Moreover, the impacts of location and accessibility of the household differ under the same promotion type. Living in a rural area decreases the proportion of branded products sold but increases the proportion of private label products sold under volume promotion.

The findings indicate that price promotions are more likely to be used for private label products and volume promotion for branded products. This suggests that the retailers encourage consumers to purchase private label products for a lower price to e.g., make them try a new product knowing that they earn greater margins and a higher profit with the sales of private label products. Consumers in general are less open to try new private label products but might be encouraged to try a new own private label product for a reduced price and then make the first purchase and will possibly convert to a loyal buyer of the private label brand (Dobson and Chakraborty 2015). Moreover, from consumers' point of view the reduced price strategy succeeds because they are more likely to experiment with a private label product when it is sold under a reduced price and therefore the psychological feeling of risk is reduced. Retailers gain higher margins on private labels than national brands since they produce the private labels products from unbranded manufacturers operating at lower costs (Ailawadi and Harlam 2002; Karray and Martín-Herrán 2019). Unlike price promotions, volume promotions have been found to be used on branded products. A reason might be that it is a strategy to attract consumers into the supermarket and therefore increasing consumer store traffic through offers on brands. Most brands are already known to the consumers, so retailers aim at selling well-known brands under volume promotions in bulk and do not aim at experimenting on a new product under price promotion. Moreover, selling other manufacturer's national brands in bulk leads to less inventory and stock costs, especially with a category that includes bulky breakfast cereal products with large packages.

4.4.4. Summary of key findings

Based on the results of the fractional multinomial logit analysis, the results implicate the following answers to the research question of what type of breakfast cereal products are more likely to be

promoted in a supermarket. It is needed to differentiate between price and volume promotion because each has unique implication and influences for the retailer and the consumer. But not only is the differentiation between price and volume promotion important but also certain product characteristics play a crucial role when looking at breakfast cereals sold under promotion - the brand and health status of a product lead to different strategic applications of promotions among retailers. Key findings are that the influence of the retailer's promotional strategies to encourage consumers to buy more unhealthy breakfast cereals. It has been revealed that retailers apply more volume promotion on unhealthier products, and no promotion on healthier products. Through the combination of the use of retail promotions, paired with the product's degree of healthiness and the aspect of income, retailers can shape a breakfast diet among the Scottish consumers, through influencing their habits and breakfast cereal consumption behaviour. The influence of the retailer's strategy to promote breakfast cereals has been analysed in this study and results are summarised in Figure 4.3.

Figure 4.3 Graphical summary of key findings from Chapter 4.

Chapter 4 **Supply-side orientation**	**Comparison of retail promotion types applied to breakfast cereal products**	
	Price promotions applied to…	**Volume promotion applied to…**
Breakfast cereals promoted by retailers:	- Expensive products - Private label products - Deep promotional discounted products	- Smaller package sized products - Branded products - Deep promotional discounted products - Less healthy products
Breakfast cereals across health status:	- Healthy products that are expensive and unhealthier - Less healthy products that are expensive and private label	- Healthy products that have smaller package size and are branded - Less healthy that are cheaper and unhealthier
Breakfast cereal across brand status:	- Branded products that are expensive	- Branded products that are expensive and have small packages - Private label products that have smaller package size and are unhealthier

Differentiating across retail promotion types is vital because they have contrary effects

All in all, when comparing the promotion types price and volume promotion across the whole breakfast cereal category, several independent variables exhibit opposite influences. These include the package weight of a product, the brand status, the interaction of the UK FSA score and the annual income of the household as well as the shop category discounter. It underlines the importance of splitting the dataset by promotion types as it reveals several effects that cannot be examined otherwise. In fact, each promotion type has different probabilities to be applied by the retailer on the products. Interestingly,

contrary probabilities have been found of products to be sold under price and volume promotions by the retailer. Among several product characteristics (the brand status of a product, the weight of the package and the full price level of a product), contrary effects have been found on the probability to be promoted either under price or volume promotion. Among socio-economic characteristics, the number of children in the household as well as the interaction of the health status of the product and the income reveals opposite effects. Moreover, a product being sold under price or volume promotion also has an opposite influence for the shop category "discounter".

Are less healthy breakfast cereals more likely to be promoted than healthier ones by the retailer?
The empirical results from Kantar Worldpanel data show that the healthiness of a product affects the probability to be sold under promotion – unhealthier breakfast cereals are more likely to be sold under price and volume promotion across the whole category but also across the different health and brand status of a product. Among healthy products, price promotions are applied to the unhealthier ones, and products are more likely to be sold under price promotion as they become less healthy. This encourages the consumers to choose unhealthier products across the healthier product range because they are incentivised through a promotional offer. Considering the whole sample of breakfast cereals, in general volume promotions are used on less healthy products. More specifically, among three subsamples of the data, which are less healthy products, branded and private label product, the unhealthier the product is, the higher the likelihood to be sold under volume promotion. Regarding less healthy products, retailer are encouraging/ offering consumers to buy less healthy products (in terms of quantity), which impacts their breakfast cereal diet. Having found that breakfast plays an important role in the diet, the author argues that it is vital to understand influences on consumer's purchase and consumption behaviour and therefore on the overall diet.

Does the package size matter when promoting products?
Price promotions are more likely to be applied to larger products and smaller packages are used for volume promotions. Larger packages have lower unit prices compared to smaller packages and therefore allow greater absolute margins because the marginal cost of the extra food added to the package is often minimal compared to its perceived value for the consumer. The increased consumer value as well as the lower costs for packaging are an advantage for the manufacturer for either branded or private label products (Chandon and Wansink 2010). Package sizes are an important characteristic of the breakfast cereal category which is underlined in the data because it shows that the same product is sold under several different sizes, e.g. Kellogg's cornflakes are sold in four different sizes (375gm, 500gm, 750gm, and 1000gm). For the consumers, a larger package means a greater value for money and more weight of the product for a reduced price.

Retailers are more likely to use volume promotions for smaller packages and it seems that consumers prefer it due to the fact that a volume promotion often includes a multi-buy so the consumer already receives multiple units of a product, which is an increased value for money. Moreover, breakfast cereals are a category with large packages, which are difficult to store and transport, hence this may represent a plausible reason for the higher probability that smaller packages are preferred under volume promotion. A volume promotion is often preferred by the consumers because it reduces the consumer's time, transaction and monetary costs (Foubert and Gijsbrechts 2010). Therefore, a possible reason is that a price discount gives the customer an incentive to buy one single but larger item under promotion, whereas the barrier is higher to try a new product when it has to be bought under a volume promotion and therefore urges the consumer to purchase multiple items of an unknown product. Especially looking at the breakfast cereal category, which is a category characterised by large packages and a multi-buy might be too much weight of the product.

Specific households respond to promotions applied by retailers

A few important household characteristics findings from this analysis need to be discussed. The results for the age of the principal shopper has the same implication for the price and the volume promotion. Younger households are more likely to respond to promotions because they might experiment more and are more open to try something new when it is sold under promotion. Younger principal shoppers are more susceptible to try a product if there is a reduction in the price. Older consumers might know their preference for products and purchase what they need regardless of any promotional offer or not. This study reveals that retailers target female principal shopper with branded products under price promotion. The presence of a female principal shopper could show the proneness of women to buy the associated quality and trust in brands compared to private labels. Another plausible explanation could be that women are attracted to the marketing and packaging of branded products. Also, they might be more deal prone getting a good deal for a brand compared to male principal shopper.

It is expected that higher income households are targeted with healthier products because higher wealth serves as a proxy for better access to nutrition information and therefore more healthy purchases (Binkely and Golub 2011). This contradictory result may imply that richer household are more likely to experiment when an less healthy product is under price promotion because these households are not scared to risk a "mis-purchase" because they can afford the extra money spend in case, they don't like the product. The higher the average annual income, the higher the likelihood to purchase a higher proportion of less healthy products under price promotion. Although it is expected that richer households due to higher level of health awareness and nutritional education are less likely to purchase less healthy products, retailers are more likely to sell less healthy products under price promotion compared to no promotion. A possible reason could be that richer consumers prefer price promotions to experiment on new, less healthy products. Another measure of wealth is the Scottish Index of

Multiple Deprivation (SIMD) and it has been found that the least deprived households are more likely to be targeted by retailer's price promotion on branded products, which are associated with trust and assured quality for a reduced price. The most deprived therefore are less likely to be targeted by price promotion for branded products because value for money might be more important than a brand status. Additionally, the findings confirm that the location of a household (urban or rural) plays an important role when looking at purchases under volume promotion across different brand status of the products. While urban household are more likely to be targeted by branded products under volume promotion, the opposite is true for rural households because they are more likely to be targeted by private label products. This could be attributed to the fact that brands reflect quality and prestige or even a trend followed in an urban area, whereas private label products are preferred in rural areas because they receive more value for money.

4.5. Conclusion

Recognising the important role of retail promotions applied in supermarkets, this study investigates the influence of product, household and shop characteristics on breakfast cereal products sold under different promotion types, with an emphasis on health and brand status of the products. The purpose is to identify the factors that affect selling products under promotions from a supply side orientation. This was addressed through a fractional multinomial logit model run on product-level data. Three separate models were analysed across the full breakfast cereal category and separate for healthy and less healthy breakfast cereal products as well as separate for branded and private label breakfast cereal products. The results of this study can be broadly categorised into two groups: the retailer's strategy when promoting breakfast cereal products and the influence of promotions on consumer's breakfast diet.

First, the findings shed light on the retailer's strategy when promoting breakfast cereal products. Analysing the dataset from a supply-side view, examines the retailer's promotional offers on the breakfast cereal category and how they target these promotions. The results show how important it is to differentiate between price and volume promotions, because across several product characteristics such as the brand status of a product, the weight of the package and the full price level of a product, contrary effects have been found on the probability of a product to be promoted either under price or volume promotion. Moreover, the dataset has been split and analysed by health and brand status of a product. The results suggest that the less healthy a product is, the higher the probability that a product is sold under both promotion types. In addition, the likelihood to promote a product is different across the label of the product. Across the whole sample, price promotions are more likely to be used to sell private label products whereas volume promotions are more likely to be used for branded products.

Some findings can be related to the influence of retail promotions on consumer's breakfast diet. Through the combination of the use of promotions, paired with the product's degree of healthiness and

the aspect of income and money spent in supermarkets, retailers can shape the breakfast diet among the Scottish consumers, by impacting their habits and breakfast cereal purchases. Overall, through promoting unhealthier products especially through multi-buys, retailers are encouraging consumers to buy less healthy products (in terms of quantity), which impacts their breakfast cereal consumption and therefore diet. Since breakfast is the most important meal of the day, the findings presented in this study argue that the influence of promotions is vital to the consumer's purchase and consumption behaviour. The role of volume promotions applied on less healthy products is especially important as larger portion size significantly increases consumption (Chandon and Wansink 2002). Looking into the impact of targeting certain socio-economic factors as a retailer, the findings suggest that younger households are targeted by the retailers to purchase less healthy products under price promotion, which encourages younger generations to eat less healthy and shapes an unhealthier breakfast diet in the future. Moreover, big families with many children are less likely to be targeted with a price promotion for healthy products, which would otherwise be an opportunity to promote healthier breakfast habits among big families.

To conclude, the results underline the important role of supermarket promotions from the retailer's point of view as well as the consumer's point of view. Retailers offer these promotions based on various product and household characteristics and households are targeted by different strategies and are therefore encouraged to purchase products under promotional offer, which then shapes their breakfast diet. In addition to theoretical implications, this study provides practical implications. The findings reveal how retailers can use promotions to influence purchase behaviour of the consumers and highlight that consumers are targeted by both promotion types on unhealthier products. However, this study strongly suggests that retailers should notice the positive effects they could achieved through applying promotions on healthier products and the possible impact it could have on encouraging healthier consumer's diet. Moreover, it is important to mention that these applied promotions are mainly volume promotions, which are used on less healthy products, so consumers purchase these products in bulk and also consume more. A recent report mentions that a consultant dietician in public health nutrition at NHS Ayrshire & Arran urges the government of Scotland to ban multi-buy promotions on high-sugar breakfast cereals to reduce another obesity risk factor. The findings of this study are reinforced through this article and the UK government plans to bad multi-buys on less healthy products as part of several policy plans as presented in Chapter 6. Additionally, the results provide rationale for the recent promotional practices that affect less healthy purchases and show that retailers are less likely to aim for big families with several children with a price promotion for example on healthy products. This would be an opportunity to promote healthier breakfast habits among families and encourage healthier eating patterns and habits among children. A more obvious finding could be used by the retailers to shape the Scottish breakfast diet for the better; the results show that the deeper the discount across all categories and subgroups, the more likely all products are sold under both promotion types.

The deeper the discount, the higher the probability that at a product is sold and purchased under promotion, therefore it could be used as a tool to change the consumer's diet when more healthy products are more deeply discounted.

Although the study fills a research gap in terms of the influence of promotion types on products sold by the retailer and included the component of health and brand status of a product, it is not free of limitations. The results are influenced due to the fact that some variables might have been measured differently. For once, this study uses a specific UK FSA nutrient profiling model, in order to assess the degree of healthiness of a product, but different measures of healthiness might result in different result based on a different healthy and less healthy categorisation. Furthermore, due to the fact that the model captures an aggregate of purchases over a year expressed as proportions, it represents an average of regular purchases and does not explain "experimental purchases". Because the data is aggregated by product level, the shop and household characteristics are only aggregated averages expressed in proportions across all shops or household over the year. Therefore, the generalisation of the results should be made with caution, also because the data is based on Scotland only. Moreover, a limitation of this study is that the model uses demand-side data (retail purchases made by a household) and tries to estimate the supply-side orientation in order to extract information about the retail strategies and how they appeal to consumers through the use of promotions. However, Chapter 5 will examine the issue from consumer's perspective. Another important factor to consider is that the purchased products under price promotion represent the promotion that has been purchased in the supermarket, but it does not include the combined effect of other influence on the purchase such as the frequency and duration of the promotion, the competition of other retailers and manufacturers. Other marketing activities such as display promotions or TV advertisement is unknown as well as the consumers shopping characteristics such as brand loyalty. To conclude, this given data only includes purchased promotion items and no other offered marketing promotional activities nor consumer preferences.

Chapter 5

5. The influence of retail promotion types on consumer breakfast cereal purchases

5.1. Introduction

Evidence shows that marketing in the retail environment including in-store promotions is effectively influencing purchases and preferences of consumers. The combination of offering a temporary discount to the regular price impacts consumers in their purchase decision, which usually should not result in intervening in a market, however the influence of these promotions might contribute to poor health outcomes. Overall, the retail promotions seem to support consumers as they offer saving money, but research has shown that promotions encourage consumers to purchase more than what they intended to buy and therefore lead to stockpiling and overconsumption (UK Government 2020b). Nonetheless, not all promotions are alike. In fact, the promotion type plays a key role as volume promotions (compared to price promotions) have been found to cause greater sales uplift, which especially matters when applied to HFSS foods contributing to excess consumption as they are widely available, affordable, and often over consumed increasing the chances of obesity in the long term (UK Government 2020).

Shoppers and consumers across different population segments, for instance families, differ in the extent to which they purchase price promoted foods and beverages from a supermarket (Smithson et al. 2015). Price promotions applied to an unbalanced food environment promoting the purchase and consumption of unhealthy foods especially among certain subgroups might worsen the situation of inequalities among different socio-economic groups (Zorbas et al. 2020). Is there a difference in purchase behaviour of consumers that buy breakfast cereal frequently compared to irregularly and does their perception towards retail promotions differ? What factors increase the number of purchases among households? What socio-economic characteristics play a role on the consumption of breakfast cereals?

Most studies that investigate the influence of socio-economic determinates on food and health refer to the socio-economic status (SES) of groups within a population. SES is often described through indicators such as income, education and employment. These three indicators appear most frequently in empirical work and all are significantly related to food purchases (Pechey et al. 2013; Nakamura et al. 2015; Taillie et al. 2017).

In the previous chapter, the descriptive analysis as well as the fractional multinomial logit model are applied to the Kantar Worldpanel dataset on product-level, revealing insights on how retailers use retail promotions on breakfast cereals. Three key messages are that: (i) the unhealthier the breakfast cereal the higher the probability that the product is sold under volume promotion; (ii) price promotions are applied more on private label products and bigger packages; and (iii) younger households are targeted by the retailers to purchase less healthy products under price promotion and also families with many children are less likely to be targeted with a price promotion for healthy products shaping consumer's diet. But how are consumers' purchases influenced by promotions when shopping in retailers? This chapter aims to shed light to the influence of retail promotions from a demand side. To this aim, a quantile regression model is employed to identify the factors that increase purchases and whether promotion types affect consumption differently. While the product-level data was employed in the previous chapter to examine the supply side of retail promotions, in this chapter in order to assess the consumer's side, the household-level data is analysed by quantile regression looking at the full distribution of purchases. Evidence shows that promotions uplift sales and increase purchases. The findings of this study suggest that the application of promotions can encourage purchases of certain healthier products, which can be used to shape the food environment promoting healthier breakfast cereals purchases. This empirical chapter contributes knowledge to existing literature and studies in a number of ways. First, investigating different retail promotion types and their influence on purchases made with rich scanner data is a novelty as so far only one study has considered more than one promotion type with the UK scanner data. The role of different promotion types is examined comparing price and volume promotions distinguishing their effects. Moreover, this study contributes to the literature from a methodological point by applying a quantile regression model to give deeper insights across the full distribution of the data.

The rest of the chapter is organised as follows. Section 5.2 gives an overview of the current literature on food consumption across socio-economic groups and the role of retail promotions. Section 5.3 explains the methodology, introduces the quantile regression approach and presents the data, Section 5.4 discusses the empirical findings across promotion types and Section 5.5 concludes.

5.2. Food consumption across socio-economic groups

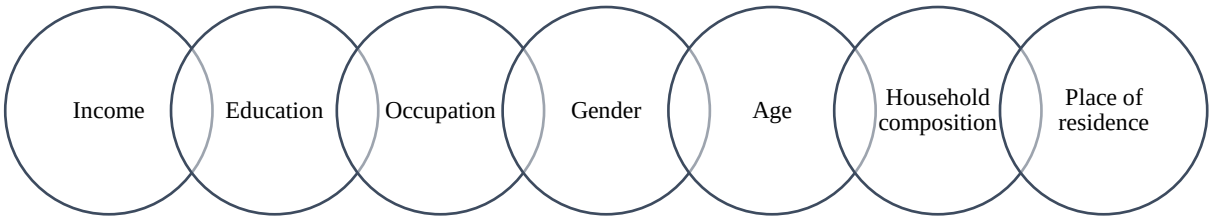
The influence of the food environment and how foods are displayed at supermarkets strongly has the potential to change and improve diets and some UK supermarkets have introduced policies to improve the nutritional quality of the food displayed. Ejlerskov et al. (2018a) assess different food policies in the United Kingdom and find that households with older main shoppers and those in the most and least affluent social grades may be most responsive to supermarket checkout food strategies. The older and more affluent groups tend to have healthier diets overall. Unhealthy dietary habits, obesity and diet-related chronic diseases are often prevalent among certain socio-economic groups, with higher prevalence among those of lower socio-economic position (Ejlerskov et al. 2018b).

A report by Placzek (2021) was published by the author as part of a secondment at the Organisation for Economic Co-operation and Development (OECD) during the PhD. It highlights why the household-level research linked to specific socio-economic determinants is highly important as it shows that socio-economic and demographic household characteristics impact the healthiness of food choices. It gives implications for policy makers analysing policy effectiveness based on a four-track approach, which is included in Chapter 6 on policies. Further, it mentions that most studies mainly focused on income, education and employment status, which appear to be strongly related to food purchases and therefore the consumer' diet. Combining these indicators into one measure of "socio-economic status" is then classified as a lower score typically denoting households with lower incomes and educational attainment, and/or lower labour market participation. The report illustrates the relationship between SES and healthy (fruits and vegetables) as well as less healthy (ultra-processed foods) food choices. The report mentions that fruit and vegetable purchases representing healthier food choices have been made more by consumers with a higher SES score. They are more likely to consume fruit and vegetables in higher quantities, but also in greater variety (Darmon and Drewnowski 2008).

Part of less healthy food choices is the ultra-processed food category, which includes breakfast cereal products overall as described in the literature review in Chapter 2. It states that households that belong to a lower SES group tend to consume more processed foods whereas more educated, wealthy and less disadvantaged households spend a smaller proportion of their total household food budget on processed foods (Placzek 2021). Overall, the consumption of ultra-processed foods (UPF) has increased world-wide and this food category is characterised by high availability, low cost as well as strong marketing presence (OECD 2021). The food category breakfast cereals is also classified as ultra-processed food products however, not all products in the breakfast cereal food category are ultra-processed. Ultra-processed foods are sweetened breakfast 'cereals and ready-to-eat cereals, whereas plain oats, plain corn flakes or shredded wheat are minimally processed foods, while the same foods are processed when they contain sugar and change to ultra-processed if they contain flavours or colours (Monteiro et al. 2018). Food choices have been linked to a section in the report that deals with the influence of socio-economic and demographic determinants of consumption behaviour. An overview is

given which includes income, education, occupation, gender, age, household composition and place of residence, but also informs about food preparation and cooking skills.

Figure 5.1 Overview of socio-economic and demographic factors influencing food choices.



Source: Placzek (2021)

Figure 5.1 shows the key factors that influence food choices, which are discussed in detail in the report. This empirical study in the thesis includes these factors in the analysis: gender and age of the principal shopper, household composition through the number of adults and children in the household, and place of residence through the postcode categorising rural and urban households. Moreover, the analysis includes a specific Scottish measure of deprivation (SIMD), which combines various factors[2] such as income, education, occupation in one measure. Overall, this chapter addresses the limitations outlined in the OECD report for instance the lack of data and the need for further research on the food environment including the socio-economic and demographic factors. The report mentions a lack of recent and in-depth data, including disaggregated data with relevant social and demographic factors based on adequate sample sizes. This is addressed in this study making use of Kantar Worldpanel data for around 3000 Scottish households including socio-economic characteristics as well as detailed product and shop information. Further, it calls for linking information on supermarket purchases with data on household information, as well as food composition data to be able to then assess the nutritional value of the products. This study includes not only household purchases, but also links detailed household information and nutritional information for each product (i.e., UK FSA Score).

This second empirical chapter of the thesis deals with the socio-economic background of the consumers who purchase their foods under promotion. However, among many studies, there is no consistent characterisation of the term "socio-economic groups". Studies base their definition on different characteristics such as occupation or income (Turrell et al. 2002; Hulshof et al. 2003; Pechey et al. 2015) or takes up to seven different characteristics into account (Ball et al. 2015; Whybrow et al. 2017). Findings also differ, ranging from no connection between socio-economic groups and food

[2] Consists of current income (28%), employment (28%), health (14%), education (14%), geographic access (9%), crime (5%), housing (2%).

consumption to a strong and significant link (Turrell et al. 2002; Hulshof et al. 2003; Appelhans et al. 2012; Pechey et al. 2013; Ball et al. 2015; Nakamura et al. 2015). In the first instance, it is important to mention that there is no consistent characterisation of socio-economic groups in the literature and definitions can differ by taking various characteristics such as age, sex, income, education, occupation into account (Turrell et al. 2002; Hulshof et al. 2003; Ball et al. 2015; Pechey et al. 2015; Whybrow et al. 2017). This will be identified further in the section on the research gap and a summary table of different definitions is provided across recent articles. This study will include a range of socio-economic characteristics of households including individual level as well as overall household characteristics, ranging from the age and gender of the principal shopper, to the household size, but also measures of accessibility and the level of deprivation of the household.

Evidence shows socio-economic inequalities in the prevalence of non-communicable diseases including diabetes type 2, cardiovascular disease and cancer, the key determinants of which are behavioural risk factors, including unhealthy diets (Afshin et al. 2019). According to the literature and reports from the WHO and the Scottish government, obesity and overweight is more prevalent in low socio-economic groups. Further, the consumption of unhealthy diets is also strongly patterned by socio-economic status (SES) [3] (Darmon and Drewnowski 2008; Appelhans et al. 2012; Pechey et al. 2013; Pechey et al. 2015).

Several studies have investigated household food purchases focusing on various socio-economic characteristics and they have found that socio-economically disadvantaged consumers purchased less healthy foods compared to higher socio-economic groups (Turrell et al. 2002; Hulshof et al. 2003; Appelhans et al. 2012; Pechey et al. 2013; Ball et al. 2015; Nakamura et al. 2015; Revoredo-Giha et al. 2018). Part of the obesity problem might be attributed to consumption patterns: lower SES purchase less fruit and vegetables, yet more energy-dense and nutrient poor foods such a processed meat high in fat and sugar. Several studies agree that among higher socio-economic groups, purchases contain a greater proportion of energy from healthier food and beverages especially fruit and vegetables as well as fibre and most micronutrients. Moreover, a higher percentage of their energy is obtained from sugars and protein and their higher energy cost are associated with lower total fat and higher proportions of protein, dietary fibre, and vegetables.

According to Pechey et al. (2013), lower socio-economic groups purchase a greater proportion of energy from less healthy foods and beverages whereas higher SES groups more from healthier food and beverages. Another study closely related to this study is conducted by Turrell et al. (2002) who report that consumers from socio-economically disadvantaged backgrounds are less likely to buy goods that are comparatively high in fibre and low in fat, salt and sugar, generally speaking healthy foods.

[3] In the literature SES is defined differently based on the data available. It is not meant to be classifying people into "lower and higher" groups but instead is used as a simplification measure.

Their findings agree with Ball et al. (2015), who state that consumers from a socio-economically disadvantaged background have a lower intake of fruit and vegetables and higher intake of energy-dense, nutrient-poor food compared to less disadvantaged groups. The authors investigate characteristics such as age, country of birth, marital status, highest education qualification, household income and children at home. Another study by Hulshof et al. (2003) even gives more details of the products consumed by low and high socio-economic groups. Comparing the consumption of low and high SES groups, the authors find out that lower SES groups have a higher consumption of for example potatoes, meat, and fat compared to higher socio-economic groups, whereas high SES groups consume more vegetables, cheese, dietary fibre and most micronutrients as well as a higher consumption of vegetables and fruits in general. A study documents that food with higher than recommended levels of fat and energy is more likely to be purchased by those with lower socio-economic status (Howard Wilsher et al. 2016).

Appelhans et al. (2012) look at relationships of SES with energy cost ($/1000kcal) and nutrition. The authors conclude that higher energy cost is associated with lower total fat and higher proportions of protein, dietary fibre, and vegetables. In hand with this goes their finding that low-SES shoppers purchase calories in inexpensive forms and which are higher in fat and less nutrient-rich. But the results show that household income is not directly related to most nutrient measures. It is worth pointing out that the study only scrutinises one American supermarket over 4 months' period and the results therefore cannot be generalised. Nakamura et al. (2015) also investigate the impact of socio-economic differences and no significant socio-economic status gap in the purchases of less healthy foods made on promotion is observed. Pechey et al. (2015) look at fruit consumption across socio-economic characteristics. They mention the differences in eating motivations across socio-economic characteristics such as nutritional knowledge and cost and health considerations, as well as the perceived satiety of food satisfying hunger as a primary motivation to eat. Lower SES and men regardless of SES report eating fruit less frequently and participants in higher SES groups, compared with lower SES, are more likely to rate health and weight control as stronger motivations for their food choices, and furthermore rating price as less important. However, the literature generally agrees that food-related behaviours are complex and determined by a combination of several factors, including not only socio-demographic characteristics such as education, income, ethnicity and availability of food but also physiological, behavioural and lifestyle factors; as well as knowledge and attitudes related to diet and health (Sumi 2018).

5.2.1. Promotional purchases made across households

Purchases made and therefore consumption patterns across households differ as highlighted in the section above and can be differentiated by specific socio-economic characteristics. These purchases

however, might be influenced by promotional offers made in the supermarkets and therefore impact purchases made. A growing concern is expressed in the current literature and government reports about the impact of promotional offers on shaping consumer preferences and purchases – towards less heathy food choices. Not only are retail promotions used to influence purchases, but also towards less healthy options and lead to purchases that were not intended and leading to almost 20% extra purchases through volume promotions (UK Government 2020). Overall, it is important to inform on the role of different socio-economic factors and the influence of retail promotions on purchases across different groups to be included in future programs but also for policy makers that try to improve diets and reducing diet-related disparities targeting specific SES groups.

The evidence in the current literature however is not clear on the extent of the impact of promotional purchases across different SES groups. A study by Taillie et al. (2017) looks at the promotional purchases made across households and mentions that evidence shows the importance of examining across various SES groups. Low SES groups are prone to have a stronger link between price, diet and weight compared to other groups and are more price-conscious and cost-conscious and therefore take advantages of retail promotions. Nevertheless, their findings are unexpected: a higher prevalence of purchases is made under retail promotion for higher SES compared to low SES groups. Reasons might be that higher SES groups purchase more in traditional retailers and are therefore more exposed to price promotions compared to consumers in discounters, who make use of the "everyday low prices" strategy. Discounters tend not to promote extensively and instead consistently offer low price items, which do not appear as part of promotions (Smithson et al. 2015). This highlights the need to include the shop information in the analysis accounting for differences in the preferred retailer of the consumer and to improve the complete picture of the retailer environment influencing purchase decisions.

Coker et al. (2019) examine the role of promotional shoppers among the purchases and find that high promotional shoppers purchase a higher quantity of unhealthy foods and beverages, less fruits and vegetables and their purchases are higher in sugar and lower in fibre compared to low promotion shopper. Approximately 11 additional unhealthy items are purchased per month across high promotional shoppers. Linking this purchase behaviour to diet and health, high promotional shoppers (the quarter of shoppers who buy the largest proportion of their basket on promotion) are 28% more likely to be obese than low promotional shoppers. The study uncovers the relationship between overweight/ obesity and purchases with a promotion across all income groups, which is independent of age, life stage, and region.

Zorbas et al. (2020) points out that low socio-economic groups are more sensitive to price promotions, as shown in the existing literature. Other studies (Nakamura et al. 2015; Taillie et al. 2017), find that price promoted products are purchased to a greater extent by households with a higher SES background compared to low SES groups. The inconsistent findings regarding socio-economic

differences in purchases made with retail promotions may reflect country-specific retail contexts such as store and price promotion availability across socio-economic areas but also the cultural differences in price promotion sensitivity (Zorbas et al. 2020). Bennett et al. (2020) mentions the need for further research that it should focus also on the understanding of the causal influence across retail promotions on food purchases and how this differs across socio-economic background of consumers. Evidence reveals that price promotions lead to stockpiling behaviour more among higher SES groups. This related stockpiling practice also increases consumption and large volume of food and beverages at home increases energy intake and overconsumption believing that products have been bought cheaper under offer (Chandon and Wansink 2002). A possible explanation is a higher disposable income among higher SES groups that live in larger homes and therefore have more space to store products and better access to transportation compared to lower SES shoppers (Bennett et al. 2020). Policies targeting price promotions that particularly deal with lower socio-economic households are discussed and evidence indicates that such promotions increase expenditure due to impulse buying and stockpiling (DrèZe et al. 2004). However, in order to understand how promotional offers influence household purchases, it is critical to investigate specific household characteristics individually and how they impact purchases made under promotion.

Overall, the literature review highlights that there is limited research describing a clear finding of the prevalence and influence of price promotions on food products. Of the recent evidence that is available, across a range of countries (mainly including the USA, the UK, Australia and New Zealand), price promotions applied to unhealthy products are ubiquitous in the retail environment. However, it gives an indication that promotions are more commonly applied to less healthy foods compared to healthier ones (Backholer et al. 2019). Evidence is mixed as well dealing with the influence of food retail promotions according to level of SES groups. Recent evidence in New Zealand (Zorbas et al. 2019) highlights that more purchases bought under promotion by lower income households, and a UK study (Coker et al. 2019) found a similar level of price promoted purchases across several income groups. Whereas an analysis from the US (Taillie et al. 2017) as well as a study in the UK (Nakamura et al. 2015) reveal a greater prevalence of price promoted food and beverage purchases for higher-income compared to lower-income households. Therefore, in the following section specific socio-economic characteristics of consumers will be examined instead of one grouped variable.

5.2.2. Specific socio-economic characteristics of consumers and retail promotions

In the literature, socio-economic status (SES) is often used and is a multi-dimensional measure that is often characterised through a combination of different measures such as occupation, education and income, which all influence food choices and purchase behaviour and therefore diet quality. Sometimes they are used as an approximation for other determinants such as culture, knowledge and skills, or

external environments including neighbourhood characteristics (Cornelsen et al. 2019). Different socio-economic characteristics represent why consumers make the food choices that they do. For instance, income does reflect the economic resources available to individuals, whereas education might be a proxy for instance for knowledge or ability to use nutritional information. The occupational group might represent social networks amongst other factors (Pechey et al. 2013).

In the literature the term higher and lower SES is used frequently using different definitions based on the research. This study clarifies several definitions across recent studies and a summary table identifies them in more detail. The literature on SES shows differences across the definition of the socio-economic status of households. Although certain socio-economic and behavioural characteristics (such as education and income level) are helpful in explaining promotional purchase behaviour, it is also likely that other interrelated factors (for example health-related behaviours) might influence their purchase behaviour for food products. All of these factors could result in unobserved individual heterogeneity, which in turn may affect individuals' purchase behaviour (Segovia and Palma 2015). Also, interactions with several individual psychological and social factors may influence dietary purchase and consumption behaviour beyond socio-economic characteristics such as income (Howard Wilsher et al. 2016).

Gender

When analysing the influence of socio-economic characteristics on the purchase behaviour, the gender of the consumer plays a crucial role. Studies in the retail environment literature demonstrate differences between male and female consumers in shopping style, behaviours, attitudes and perceptions (Mortimer and Clarke 2011; Babin et al. 2013; Borges et al. 2013; Yildirim et al. 2015). On the one hand, gender differences influence food choices. Studies have found that male main grocery shopper, are associated with a high level of income, education and work in professional occupations and also are mostly found to be 34 years old or younger. Moreover, the men that do the main food purchases, limit price comparison and do not pre-plan before going into the supermarket but rather search deliberately when entering the store. Furthermore, men mainly use the same shop, do not compare prices, and do not stick to a fixed budget while women search and shop around in order to find the best buy (Mortimer and Clarke 2011). Women are more involved when going for a shopping trip as they plan ahead, go shopping more often and are less interested in simply getting the shopping trip done with as shopping is part of the social identity for female compared to male consumers. Furthermore, they are more likely to seek out price discounts than men (Borges et al. 2013). Another difference between genders and food choices is the purchase of different food products. Women rate the food choices related to health behaviours as more important compared to men and have healthier lifestyle patterns in general and a greater awareness about health-diet relationship implications. Women embrace dietary changes to improve health and tend to have a diet with higher micronutrient. In addition, male consumers eat fewer fruit and vegetables and

less low-fat products and high-fibre foods than women do (Wardle et al. 2004). Nevertheless, a study finds that fatty-sweetened foods vary with the sex of the consumers, showing a higher intake among women while the consumption of sweet foods such as cakes, biscuits, puddings and chocolate is tacitly treated by men and women as a marker of femininity in many cultures (Mejean et al. 2011).

On the other hand, gender also influences the purchase behaviour when dealing with promotions. Studies have found that women are more likely to be sensitive to monetary sacrifices and therefore value promotions that can reduce such a sacrifice. Moreover, female consumers are more aware of regular prices and price promotions and these specials and discounts are more important for women than men (Mortimer and Clarke 2011). Mortimer and Clarke (2011) mention in their study that men compared to women take less time to complete the food shopping trip, also purchase fewer items but pay a higher price per item. Besides that, men take less time to select products and limit price comparisons and pre-planning before going shopping. Further, they find that specials and regular promotions vary in their degrees of importance depending on the consumer's gender, education and occupation and that for female consumers weekly specials and regular promotional discounts are more important than for men. Overall, regular offers and promotions are important to older, lower educated, female workers (Mortimer and Clarke 2011).

Age

Understanding the importance of the age of consumers linked to the aging population as the proportion of the population aged 65 and over has increased from less than 9% in 1960 to more than 17% in 2017 and is projected to increase up to 27% by 2050 (OECD 2019b). Several studies have investigated the influence of age on consumers purchase behaviour towards promotions. The use of sales promotion shows significant differences across age. Young consumers (25 years or younger) tend to take advantage of promotions and enjoy the benefits of purchasing a product under price promotion. However, contrary results show that older consumers are more price sensitive and deal prone and in favour of promotion methods such as free samples or coupons.

The study by Pei Jie Tan and Svetlana Bogomolova (2015) shows that young consumers with low-income levels are the most vulnerable group of shoppers. This group of young adults representing the future population finds it difficult to understand and effectively use price promotion information and make mistakes during their purchase decisions, which might lead to overspending and overborrowing. As part of demographic characteristics, the low-income level has been found to be the strongest predictor of price promotion literacy levels. Consumers with a high-income level have higher information processing capacities and are better at interpreting information on food labels, whereas lower income level and lower age are the strongest predictors of low numeracy levels. Besides, the consumption of foods changes across age groups of consumers. To illustrate, the intake of fatty-salted and fatty-sweetened foods decreases with age, which can partly be explained by the fact that older

consumers purchase less energy-dense sweets and fast foods because of physiological and psychological changes (Mejean et al. 2011).

Income

When dealing with socio-economic background, the income of the consumer is highly important. Steenhuis et al. (2011) look into the role of price when purchasing foods among socio-economic groups and they mention that low-income consumers are significantly more conscious of value and price than higher income consumers. Turrell et al. (2002) investigate the socio-economic patterns food purchasing. The authors use three socio-economic measures (education, occupation, household income) and all are significantly related to the food purchases. They report that the economically disadvantaged households purchase fewer fruits and vegetables. All in all, income is the strongest factor in the purchase of food especially fruit and vegetable– stronger than education. A study by Hulshof et al. (2003) claims that in low income groups overweight and obesity is more prevalent than compared to higher income groups.

Taillie et al. (2017) analyse US purchase data comparing high and low SES households across their consumption behaviour. They defined SES by household income from the IRI data and grouped into low-, middle-, or high-SES based on the Federal Poverty Level (≤135%, 136–300%, >300%, respectively). Their results indicate that higher SES households have a higher prevalence of purchases under price promotions compared to low-SES. Higher income households purchase more food (33%) and beverages (35%) under a price promotion compared to lower income groups with food (26%) and beverages (28%). The literature has suggested that low-income consumers tend to be more price and cost-conscious, but also more sensitive to price promotion strategies. Literature however remains mixed regarding whether low-income consumers are more or less responsive to price changes. An explanation for these findings might be that the results reflect differences where households shop, rather than responsivity to price promotion. Low-SES groups purchase more products in shops that offer "everyday low prices" and often do not use price promotions, whereas higher-SES might be more exposed to price promotions based on the shops they go to such as traditional retailers (Taillie et al. 2017).

McDonald and Milne (2018) wrote reports for Food Standards Scotland in 2016 and 2018. It is reported that in the United Kingdom lower income households purchase a lower proportion their food and beverages budget on price promotions (33%), compared with the highest income group (39%). Overall, there is a minimal difference in calories purchased on price promotions. The report in 2016 documents no significant differences in the proportion of energy purchased on price promotion between quintiles of SES. A similar result has been found by Revoredo-Gina et al (2018) looking at price promotions across Scotland. The authors argue that promoted food and beverages are similarly purchased across all quintiles of the Scottish Index of multiple deprivation (SIMD). A study by Ball et al. (2015) finds out that among various variables there is no strong evidence of moderation by income

or education. Powell et al. (2016) define the socio-economic groups by quintiles of the median household income and a categorisation between urban, suburban and rural, however, no systematic variation in the prevalence of price promotions by socio-economic characteristics is found.

Education / Schooling

"Education" is another significant part of the socio-economic background. A higher level of education is often related to an increase the ability to obtain but also to understand health-related information in particular needed to develop health-conscious behaviour in terms of food consumption and diets (Sumi 2018). High consumption of fatty-salted or fatty-sweetened foods is associated with other unhealthy lifestyles, including low physical activity, smoking habits and alcohol consumption. The literature is not consistent in the results of how individuals consume across different levels of education. Mejean et al. (2011) observe that low- and middle-educated individuals were lower purchasing consumers of fatty-sweetened foods, however others find that a higher intake of high-fat dairy products, cakes and desserts in households associated with a lower education level. Unlike the above authors, Appelhans et al. (2012) argue that the indicator education is not directly related to most nutrient measures. A study from Turrell et al. (2002) identifies that the least educated households purchase fewer fruits and vegetables and less regularly compared to the more educated groups. Besides, healthier purchases are made by more-frequent trips and fewer small trips as well as visiting more store chains. Hulshof et al. (2003) observe that in the higher education groups less fat and oils were being consumed.

Occupation

Nakamura et al. (2015), a close study to this research, examine socio-economic variation in the prevalence of purchase of price promoted products according to product healthiness. They find that sales uplift from price promotions is greater for higher occupational groups compared to lower occupational groups. They also include variability in the healthiness across price-promoted purchases by SES and results indicate a larger magnitude of sales uplift from price promotions for higher (0.35%) compared with lower occupation groups (0.23%) in Britain. These differences are more marked in healthier compared with less healthy food categories; however, no significant difference is found in the absolute volume of price-promoted purchases of less healthy foods between occupational groups.

Another study on the impact of the food environment on consumption is done by Pechey and Monsivais (2015). They investigate the importance of the supermarket choice alongside the shopping behaviour on healthfulness and social pattering using UK Kantar Worldpanel data as well as the FSA UK nutrient profiling score system. They categorise M&S, Ocado and Waitrose as high-cost supermarkets, medium as Asda, The Cooperative, Morrisons, Sainsbury's, Somerfield, Tesco and low-cost as Aldi, Farmfoods, Iceland, Lidl and discover that high-cost supermarket costumers purchase 9% more of energy from fruits and vegetables than low-cost supermarkets users. However, there are no

differences in the purchase behaviour among socio-economic groups but underlined that indirectly the cost of a supermarket might reflect the purchasing power through income.

Families and children

Overweight and obesity among children is of great concern as it increases the risk of health problems in the future such as asthma, psychosocial morbidity, orthopaedic complications, cardiovascular problems and diabetes and these effects continue into adulthood. Already the childhood obesity rates are high in the United Kingdom - almost 23% of children aged 4 and 5 years are overweight, of whom 9 % are obese. Prevalence of overweight and obesity are higher among 11-15-year olds (34% and 19% respectively) and are almost double in the most deprived area compared to the least (Howard Wilsher et al. 2016). Tackling obesity requires several policy areas to understand the issue and besides health also include the food environment where consumers buy and eat food.

Further, the role of advertising on food choices is vital when dealing with children because they are more vulnerable to food marketing and being disproportionally targeted by advertising for HFSS (foods high in salt, sugars and fat). This is due to the fact that children transmit their wishes onto the purchasing behaviour of parents. To change this, the WHO Commission on Ending Childhood Obesity developed recommendations to reduce the impact of marketing unhealthy products to children (UK Government 2020, Placzek 2021). A study by Howard Wilsher et al (2016) identifies a significant relationship between the supermarket sales of unhealthy foods and the prevalence of overweight and obese children, and that the area of deprivation is associated with the weight of children. This cross-sectional study in England linked store-based food sales for 537 stores with 6517 UK Census Areas. Research has found that mothers in family food consumption and rituals play an important role. Even though more women are working which has changed family food consumption and food preparation, mothers still remain an important central figure in families across food consumption and preparation (Carrigan et al. 2006). Also, the circumstances of the household composition impact food consumption. Individuals who are married or living as a couple consume more fatty-sweetened foods and more energy-dense foods such as sweets and desserts compared to single people (Mejean et al. 2011).

To sum up, the literature underlines that socio-economic characteristics matter when consumers make food purchases. The background of consumers plays a key role as studies have found that socio-economically disadvantaged consumers purchase more unhealthy foods compared to higher socio-economic groups. They consume less fruit and vegetables, yet more energy-dense and nutrient poor foods such a processed meat high in fat and sugar. Several studies agree that among higher socio-economic groups, purchases contain a greater proportion of energy from healthier food and beverages especially fruit and vegetable as well as fibre and most micronutrients. However, the literature generally agrees that food-related behaviours are complex and determined by a combination of several factors, including not only socio-demographic characteristics such as education, income, ethnicity and

availability of food but also physiological, behavioural and lifestyle factors; as well as knowledge and attitudes related to diet and health.

The role of promotions among SES groups has been investigated empirically and evidence in the current literature however is not clear on the extent of the impact of promotional purchases across different SES groups. Some studies find that low socio-economic groups are more sensitive to price promotions, while others reveal that price promoted products are purchased to a greater extent by households with a higher SES background. Inconsistent findings regarding socio-economic differences in food purchases made across retail promotions may reflect country-specific and a retail specific environment such as store and price promotion availability across socio-economic areas but also the cultural differences in price promotion sensitivity.

This section has explained the effect of various socio-economic characteristics on the purchase behaviour across healthy and less healthy foods. Adding another variable to the concept, which is the promotion aspect will give the opportunity to explain the situation in more detail. Drawing on nationwide data of Kantar Worldpanel, the objective of this study is to gain a better understanding of the influence of supermarket promotions on the purchase behaviour across different socio-economic groups. Disentangling the effect among different types of promotions will underline the importance of the types across socio-economic groups and product types.

5.2.3. Breakfast cereals consumers and their socio-economic background

When looking at the breakfast cereal consumption across different socio-economic backgrounds of the households, studies have found a link between the household characteristics and the healthiness of breakfast cereal purchases. Binkley and Golub (2011) mention the difficulty of measuring the healthiness of breakfast cereals. Fibre and sugar are the most important nutrients to investigate for this food category and they applied an index similar to the UK FSA score which includes sugar and fibre, protein and fat and sodium.

Jones et al. (1996) in his early study investigate the purchase decisions of high- and lower-income shoppers on breakfast cereals and find that lower income shoppers behave according to consumer demand theory, suggesting rational purchase decisions guided by income and product price. The price of the product has the strongest effect on the healthiness of the breakfast cereals that influence consumer purchase. However, breakfast cereals are a relatively inexpensive product – especially the healthier products are the cheapest cereals. Studies show that the price gap between healthy and less healthy breakfast cereals is narrower compared to other categories (Potvin Kent et al. 2017b). The reasoning behind the positive relationship between income and healthiness is that higher income can play a role as a proxy for better access and knowledge about nutritional information (Golub and Binkley 2005). They also uncover that private label cereals are among the healthiest when comparing them to

national brands, and therefore private label shoppers make healthier purchases. The term ‘national brands’ refers to ‘branded’ product that have their own ‘brand name’, whereas the term private label describes products that are sold under a retailer’s branding. Low-income households have been associated with less healthy products preferring sugary cereals but have also been found to be generally more price sensitive. However, promotions such as price reductions are used extensively by national cereal brands – which means that promotion affine or deal-prone consumers often purchase brands. It has been found that in Scotland private label food products have been purchases under promotion for 22% compared to 43% of branded products on promotion in 2018 (Golub and Binkley 2005; Campbell et al. 2020).

Lin et al. (2017) state that households with higher income, better education, or with higher age tend to choose healthier breakfast cereals. Further, they report that low-income households prefer sugary cereals and are generally more price sensitive. However, when the price of children’s cereals (compared to adult cereals) changes, no significant different behaviour is found unless the income is below poverty level. The same conclusion has been supported by Binkley and Golub (2011) who find that older households make healthier choices as well as higher education and higher income are positively linked to healthier food purchases. The authors analyse Nielsen scanner data of four different food categories (breakfast cereals, soft drinks, bread and milk), and conclude that households with college education and higher income purchased healthier products in all four categories. In all categories except milk, increasing the age of the principal shopper is linked to better nutrition choices. Among the breakfast cereal products, Binkley and Golub report that children and teens in the household lead to unhealthier food purchases – the results were the strongest for breakfast cereals compared to other three categories (milk, bread, soft drinks). Studies show that having children in the household leads to less healthier food purchases, especially among breakfast cereals (Golub and Binkley 2005; Binkley and Golub 2011; Lin et al. 2017).

This study underlines the correlations between socio-economic status of consumers and the food choices and purchases that they make, however the causality between the socio-economic status of consumers and their food choices or health behaviour is not clear. Studies have not been able to determine whether the observed relationship between SES and healthiness of the food purchases is a causal relationship. The food choices of different SES may impact their health outcomes, but this relationship is difficult to disentangle from the range of other factors that may impact healthy food choices. SES variables may have a causal relationship on diet quality and diet costs, however it has to be acknowledged that the relation of diet quality and health outcomes may have been confounded by unmeasured socio-economic determinants (Darmon and Drewnowski 2008). Moreover, cross-sectional studies, which are often used in the literature, cannot determine causality. In other words, whether for

example unhealthy food leads to overweight/obese consumers or if overweight/obese consumers seek out unhealthy foods (Darmon and Drewnowski 2008; Howard Wilsher et al. 2016).

Looking at income as one of the main socio-economic characteristics, evidence shows that an association exists for the healthiness of a diet and income level. This relationship has been linked to the price for nutrient-rich foods and the time cost to prepare foods, but a causal relationship has not been found (Placzek 2021). In an analysis, further factors have to be taken into account because low-income consumers face challenges which are linked to their food choices, such as a higher burden of employment-, food-, and housing-related insecurity that threaten the livelihood of their household. Moreover, further underlying factors are high level of stress and poor sleep as well as a cognitive overload, which creates a mentality of scarcity influencing poor diet quality.

However, the question of causality cannot fully be answered because of methodological issues such as not being able to adjust for the transition between the income status of the individual and their obesity status that happen between the baseline and the follow up survey. Also, it important to consider that causation is not replaced by reverse causality during the life but rather coexist, which might result in a bidirectional relationship. Further research on the causal mechanisms behind SES and food and health is needed, however adjusting for underlying factors that might influence correlations and causations. Purchase data offers various advantages, however the absence of additional information such as characteristics of households that include for instance motivation or food waste. Also, further marketing activities are not included which the consumer is exposed to in the retail environment (e.g. product placements). Therefore, the author has to acknowledge that the role of promotion cannot draw causal interference across other marketing techniques as other determinants across food purchases are more important than in-store retail promotions (Zorbas et al. 2020).

5.2.4. Research gaps on consumer-side literature

Given from the literature, low socio-economic groups purchase less-healthy foods and beverages, often high in fat and less nutrient rich, as well as buying their food in inexpensive forms. Comparing this consumption behaviour to high socio-economic groups, which purchase products closer to national government recommendations, and their purchases contain more fibre, protein, total sugar and less sodium compared to lower groups. Besides, the most often discussed variables are education and income. Economic models try to explain for instance different consumption behaviour across individuals knowing that they aim for maximising their utility based on income, time and other resource constraints (Azagba and Sharaf 2012).

Table 5.1 Overview of literature describing demand-side perspective.

Author	Food / Breakfast cereals	Analysis / Method	Data type / Data year/ Country	Promotion type	SES	Healthiness
Pechey et al. (2013)	Food and beverages (43 categories)	Multiple regression	Kantar Worldpanel purchase data (Great Britain 2010)	Not included	Occupation using UK Registrar General's social classification	UK Food Standards Agency Nutrient Profiling
Nakamura et al. (2015)	Food (135 categories)	Hierarchical regression	Kantar Worldpanel purchase data (Great Britain 2010)	On/ Off promotion	Occupation using UK Registrar General's social classification	UK FSA
Pechey and Monsivais (2015)	Fruit and vegetables and less healthy foods/beverages	Multiple regression	Kantar Worldpanel purchase data (Great Britain 2010)	Not included	Occupation using UK Registrar General's social classification	UK Food Standards Agency Nutrient Profiling / % of energy from fruit & veg
Taillie et al. (2017)	Food and beverages (including RTE cereal)	Chi-square test and t-test	IRI purchase data (US 2008-2012)	Price promotion (coupons or any deal in-store)	Household income based on Federal Poverty Level and household race/ ethnicity	nutritional data from the nutrition facts panel (NFP)
Revoredo-Giha et al. (2018)	Expenditure on food and drink purchases (10 broad categories with 2460 sub-categories)	Panel data and demand system	Kantar Worldpanel purchase data (Scotland 2006-2013)	On/ off promotion	SIMD	Not included
This study	**Breakfast cereals**	**Quantile regression**	**Kantar Worldpanel scanner data (Scotland 2015)**	**Price and volume promotion differentiation**	**Key Socio-economic characteristics and SIMD**	**UK FSA Score on product-level**

Furthermore, Table 5.1 highlights the contribution to the literature from a methodological point. It shows that multiple linear regression has been used most often across quantitative studies. This research uses a quantile regression, which will be explained in the following section. This method gives more detail into various quantiles of the purchases and therefore somewhat of the consumption behaviour. However, the economic literature often analyses food purchases or sales data and not actual dietary intake therefore the term "consumption" is used in the literature differently (Hawkes 2009). Nevertheless, the table clearly underlines the gaps in the literature because using a quantile regression model will be a different technique with more insights across the full distribution as well as including more socio-economic characteristics and promotion types.

Table 5.2 Recent government reports linked to current policy.

Further recent research based on government reports and other institutions on retail promotions	
The policy options cited by the UK and Scottish governments to limit the impact of price promotions on purchasing include (i) a restriction on the use multi-buy price promotions, (ii) restricting the advertising of price promotions in-store, (iii) restricting the placement of unhealthy foods and beverages at i.e. checkout, end-of-aisle, front of store	
UK Government. Department of Health and Social Care (DHSC) Impact Assessment 2020. Restricting volume promotions of HFSS products: impact assessment	The study deals with price promotions, especially volume offers, as significant drivers of the excess purchasing of HFSS food and drink, which in turn increases consumption of these products and therefore the likelihood of being obese or overweight. It presents policy objectives and policy options as well as cost and benefits of those options.
Coker. T, Rumgay. H, Whiteside. E, Rosenberg. G,Vohra. J. Paying the price. New evidence on the link between price promotions, purchasing of less healthy food and drink, and overweight and obesity in Great Britain. Cancer Research UK. 2019	A study to describe the influence of price promotions on consumer behaviour and the implications for health. Findings include that greater proportion of purchases on price promotions on less healthy products and high promotional shoppers purchased a greater quantity of unhealthy foods and less fruit and vegetables compared to households classified as low promotion shoppers.
UK Government. Restricting promotions of products high in fat, sugar and salt by location and by price London, UK: Department of Health and Social Care; 2019 (Consultation outcome from December 2020)	The aim of this policy report is to restrict the promotion of foods high in fat, sugar and salt in favour of healthier options to help improve people's diets. Government decided to legislate to restrict promotions of HFSS products by price (volume promotions) in medium and large retailers that sell food and drink in England.
Smithson M, Kirk J, Capelin C. Sugar reduction: the evidence for action Annexe 4: An analysis of the role of price promotions on the household purchases of food and drinks high in sugar. A research project for Public Health England conducted by Kantar Worldpanel. London. October 2015.	Describes the case for policy action to reduce the influence of high-sugar price promotions in the UK and found that price promoted foods were associated with a growth in sales of 22 %, even after considering consumer stockpiling and the subsequent delayed repurchasing.
FSA Scotland. Gillian Campbell, Lyndsay Davidson, Leanne Garden, and Alana McDonald, at Food Standards Scotland. Monitoring retail purchase and price promotions in Scotland (2014 – 2018), 2020	Promotions overall have declined since 2014, and in 2018, around a third of the retail food and drink have been purchased in Scotland under a retail promotion. Purchase on promotions remains skewed towards less healthy

Source: Backholer et al. (2019)

Table 5.2 highlights the importance of the topic as recent government reports, and their findings underline the need to research further on the role of promotions and their influence on less healthy purchases. The UK government, the Scottish Government and Public Health London published all about

this topic up until in December 2020 as the Government decided to legislate to restrict volume promotions of HFSS products in medium and large retailers that sell food and drink in England.

Overall, the academic literature and government reports highlight that findings are not consistent in each study because they make use of different measures and context. Not only do the countries of studies differ (e.g., UK, US, New Zealand) but studies included for instance different measures of healthiness (UK FSA, NFP). Therefore, this study includes more than one retail promotion type, and focussing on one food category in-depth such as breakfast cereals. Nonetheless, previous researchers have not combined retail promotion types including volume promotions, linked to breakfast cereal products with an individual UK FSA score, but further include detailed information about the socio-economic background of the household.

5.2.5. Research question and aim

The second empirical chapter applies a demand-side orientation using the household as a unit of analysis and investigating the purchases made by a household instead of products sold by the retailer as in Chapter 4. This analysis looks at the scanner data from the consumer's perspective and how promotional offers influence purchases made by households. Household-level data enables to look at detailed socio-economic characteristics in the analysis as they will not be aggregated. This chapter identifies how retail promotions influence the purchases of breakfast cereal products made by households and provides insights on the purchases made across specific household characteristics. The aim of this research question is to investigate the factors that influence the purchases of breakfast cereals including the role of product and shop information but also the socio-economic characteristics of households. To address this aim, this study categorises the products into healthy and less healthy food using the UK FSA Nutrient profiling model in order to compare the influence of promotion types on purchases made by households of various socio-economic groups.

RQ2: What factors (such as promotion types, socio-economic characteristics of households, product characteristics) influence the purchases of breakfast cereals made by households?

a. What factors influence the consumption of breakfast cereals? What kind of products and household characteristics are associated with higher consumption of breakfast cereals?

b. Are households more susceptible to promotions on unhealthy products? Is there a difference between price and volume promotion to the household's responsiveness across the healthiness of products?

The broader aim is to give practical implications to influence healthier eating habits especially with regards to the socio-economic background of the consumers in order to introduce a healthier diet through promotional retail strategies among various households when examining how supermarkets target consumers and how they respond. The motivation behind this research question is gaining knowledge how consumers are influenced by supermarket promotions, and therefore giving potential to improve the overall diet of the population because the majority of food is purchased in supermarkets. Various socio-economic factors such as the size of the household or the deprivation level as well as product characteristics will be considered. This type of analysis will give an insight to the distribution of the quantity of products purchased in a more contextual setting. The left tail at the lower end of the distribution shows the low breakfast cereals consumption household, in other words the irregular breakfast cereal eaters. On the other side, the higher end of the distribution shows the household purchasing many breakfast cereals considered more the frequent consumers and what influences them compared to lower consumption households.

The contribution to knowledge in this chapter consist of the following aspects. First, the insights given from applying a quantile regression model is a great contribution beyond just an OLS model as highlighted in Table 5.1. Offering a detailed analysis across the full distribution of the data, this analysis looks at the purchases of breakfast cereals comparing low and high consumption households. Secondly, more socio-economic characteristics are included in the study. Most of the earlier studies have focussed on the UK Registrar General's social classes as a measure of socio-economic background. This research investigates various individual variables such as age, number of children or income groups but will also use the multidimensional Scottish Index of Multiple Deprivation (SIMD). This contributes to knowledge by using the socio-economic background dimension with more detail as well as focusing on Scotland, as one of the most obese regions in the United Kingdom. Moreover, two promotion types are included as proportion of purchased products as independent variables including price and volume promotions. This extends the literature considerably as previous studies only deal with on and off promotion Literature mentions that due to a lack of data, studies were unable to differentiate between promotion types (Kaur et al. 2020). No other study has linked the promotion types to the healthiness of the purchased products and therefore it is impossible to examine how households respond to for example a price promotion on healthy products and how such a promotion influences the number of purchases made. Further, deeper insights are explored on the responsiveness of household to promotions linked to the healthiness products, which is a novel feature of this study.

5.3. Method and data description

The following sections of the empirical chapter provides a description of the data set relevant for this research question, an explanation of the measurement variables and the method used to analyse the data

and the results of the analysed data. Attention will be focused on the research method and data analysis. The reason for the choice of type of analysis will be motivated.

To answer the research question, the author is interested in the distribution of low and high consumption households and this type of data used in the study offers sufficient data across the full distribution. Therefore, the quantile regression approach is used as a method and the quantity analysis provides a useful context as the variation of purchases across households impacts consumer diets. The insight on the full distribution from low to high consumption households offers contextual information detecting critical characteristics such as the household size (e.g., families) or the level of deprivation and the influence on their purchase behaviour.

5.3.1. Quantile regression

A clear gap for the literature on RQ2 is the fact that the earlier literature has investigated neither detailed socio-economic characteristics nor the distribution of purchases. The quantile regression (QR) framework provides a pragmatic approach in understanding the differential impacts of covariates along the distribution of an outcome – in this study the impact of socio-economic characteristics on the breakfast cereal consumption / the effects of household characteristics on quantity purchased of breakfast cereal products across low and high breakfast cereal consumers. In this study, the quantile regression allows to identify the differential impacts of household, product and shop characteristics on the purchases of breakfast cereals. It is important to consider in the interpretation that the findings/ estimates are only interpretable for the specific quantile level of the distribution. However, this offers information about the tails of the distribution (high and low breakfast cereal consumers) and therefore a richer description of the data instead of just the mean.

Quantile regression methods are used to estimate the quantiles of the conditional distribution facilitating a richer characterisation of the data as well as a greater robustness to outliers compared to the least-square regression. In general, quantile regressions estimate parameters through minimising sums of absolute deviations instead of squared residuals in order to be more specific when dividing the dependent variable (the weekly quantity purchased) into quantiles. The objective of the quantile regression model is to generate different conditional quantile functions and to model the effects of covariates on the conditional quantiles of the dependent variable. The quantile regression was developed by Koenker and Bassett in 1978 and extends the mean regression model to conditional quantiles of the response variable. Quantile regression is considered to be an extension of standard least squares estimation of conditional mean models to the estimation of a set of models for different conditional quantile functions and the quantiles of the conditional distribution of the dependent variable are formulated as functions of the observed covariates (Belaid et al. 2020). Quantile regression parameters estimate the impact of individual explanatory variables on specific quantiles of the dependent variable

(e.g. 10th, 25th, 50th and 75th). According to Koenker and Hallock (2001) the quantile regression can give a more complex picture of the covariate effects through estimating conditional quantile functions- so instead of focussing on what affects the mean, what affects a specific quantile, which can be of great importance when looking at the ends of the total income spectrum for example.

The quantile regression model specifies the conditional-quantile function and it facilitates the analysis of the full conditional distributional properties of the dependent variable, whereas the linear-regression model specifies the conditional-mean function. However, the linear and quantile regression model different quantities but also underlie different assumptions about the error term. Different key features of the quantile regression compared to OLS based on Hao and Naiman (2007). Quantile-regression estimation minimises a weighted sum of absolute values of residuals as opposed to the sum of squares in least-squares estimation but also QR is more robust to distributional assumptions in conditional quantiles compared to the OLS as it is lacking these detailed properties in the conditional mean. Further, the quantile regression model allows the independent variables to have a different impact across the distribution of the dependent variable, whereas the least square estimator estimates only the conditional mean of y given x. This allows the analyst to drop the assumption that variables operate the same at the different tails of the distribution just the same as at the mean. Modelling multiple quantiles also allows a more complete picture of how the distribution is influenced by independent variables, which also includes changes in the shape (Hao and Naiman 2007). Considering heterogeneity and skewed distribution in the data, therefore the OLS regression also could result in misleading regression coefficients.

A further advantage over the OLS is that the QR approach is more robust to the non-normal errors and outliers and therefore offers a more robust characterisation of the data. This methodology allows a greater understanding of the outcomes that are non-normally distributed and that have non-linear relationships among the variables. It also allows to measure the effects of explanatory variables across each percentile of the entire distribution, with the added advantage that the use of median (as opposed to mean), further reduces the susceptibility to outliers. Further, QR estimates offer responses of different quantiles along the full distribution even across opposite signs, where OLS would most probably imply no relationship. Moreover, QR offers a relative independence of bootstrapped standard errors, as well as heteroskedastic errors and lack of need for a Gaussian error structure compared to OLS (Belaid et al. 2020). Also, this method eliminates the sample selection bias through the use of the whole sample while giving different weights to each quantile (Kim 2020). Quantile regression is particularly useful if the distribution of the continuous response variable changes differently following the changes in regressors (Hao and Naiman 2007; Mishra et al. 2015; Belaid et al. 2020). In this study, the impact of price promotions on the purchases of breakfast cereals may be quite different for low consumption households that are at the 10th percentile of the distribution compared with high consumption households at the 90th percentile.

In this study, both OLS and quantile regression methods are employed in order to analyse the determinants of breakfast cereal consumption.

The starting point is the OLS model given as:

$$Y_i = \beta_0 + \gamma X_i + \varepsilon_i \tag{5.1}$$

where Y_i refers to the annual breakfast cereal quantity purchased by household i, X_i is a vector of control variables (socio-economic household characteristics, product characteristics and shop information), β_0 is the constant term, γ is the parameter to be estimated, ε_i represents the error term.

In comparison, the quantile regression model is expressed as

$$Y_i = \beta_0 + \gamma'_\tau X_i + \varepsilon_{\tau i} \tag{5.2}$$

$$Q_\tau(Y_i|X_i) = \beta_0 + \gamma'_\tau X_i \tag{5.3}$$

where Y_i refers to the annual breakfast cereal purchase by household i, X_i is a vector of control variables (socio-economic household characteristics, product characteristics and shop information), β_0 is the constant term, γ'_τ is the coefficient value associated with the τ-th quantile, $\varepsilon_{\tau i}$ represents the error term, and $Q_\tau(Y_i|X_i)$ refers to the τ-th conditional quantile of Y given the control variable X.

The estimation of the quantile regression coefficient β_τ is the solution to the following minimisation problem at a given quartile (τ) (Koenker and Bassett, 1978).

$$Min\frac{1}{n}\left[\sum_{y_i \geq \beta' X_i} \tau\,|y_i - \beta' X_i| + \sum_{y_i < \beta' X_i} (1-\tau)\,|y_i - \beta' X_i|\right] \tag{5.4}$$

Motivations for using quantile regression

To answer the research question, the author is interested in the distribution of low and high consumption households and this type of data used in the study offers sufficient data across the full distribution. The quantity analysis provides a useful context as the variation of purchases across households and also impacts consumer diets. This model adds the healthiness of products as an important parameter, contributing to knowledge of low and high consuming household adding the health perspective to it. Also knowing what other product characteristics increase purchases e.g. branded labels or the size of the pack which is linked to the overall retail environment. Further it informs on the most responsive household characteristics including the SES perspective given the household level data. Even more

important is the insight on the full distribution from the healthiest to least healthy households for a policy perspective, which will follow in the next empirical chapter, but first looking at contextual information of high and low consuming household detecting critical characteristics such as the household size (families) or the level of deprivation and the influence on their purchase behaviour.

Since quantile regression was first introduced by Koenker and Bassett in 1978, quartile regression analysis has been continuously developed especially in research areas such as applied economics and econometrics but also financial and economic statistics (Koenker and Hallock 2001; Kim 2020). Quantile regressions have been applied to the research field of economics, especially among consumptive markets. Studies have been used to examine the consumption across various groups often including socio-economic characteristics for instance on the use of household electricity demand. Table 5.3 summarises previous studies that employ QR to analyse the influence of socio-economic characteristics of households. Age has been a common variable but also the income and education as been used in almost all studies. These studies applied quantile regression analysis across their data to analyse the effects of various factors on entire distribution on the consumption spectrum instead of focusing on the conditional average. Results of these studies all show that the effects of household characteristics at the tails of the distribution are substantially different than the average. This study employs quantile regression to analyse the influence of promotions on the full distribution of purchases in Scotland in 2015. The purpose is to show that the impact of demographic, socio-economic characteristics as well as product and shop characteristics on household breakfast cereal purchases/consumption may differ across quantiles.

Table 5.3 Studies using quantile regression to analyse socio-economic household characteristics

	Socio-economic characteristics of households included in studies						
	Age	**Gender**	**Education**	**Income**	**Employ-ment**	**Household size**	**Nationality**
Han et al. (2011)	✓		✓	✓	✓		✓
Azagba and Sharaf (2012)	✓	✓	✓	✓			✓
Huang (2015)	✓	✓	✓	✓		✓	
Belaid, et al. (2020)	✓	✓		✓	✓	✓	✓
Kim (2020)	✓		✓	✓	✓	✓	
Kostakis 2020	✓	✓	✓	✓		✓	

5.3.2. Model specification

Specification of the QR model for the study of breakfast cereal consumption

The empirical chapter estimates two econometric models to investigate what factors influence the weekly quantity of products purchased. The meaning of the estimated parameters will describe the impact of the independent variables across household, product and shop characteristics on the weekly quantity purchased by the household. This analysis provides a whole new dimension, allowing the impact of key variables to be measured across the full distribution curves to determine where the greatest impact is being experienced when examining the quantity purchased of breakfast cereals.

The estimation model (baseline model) for this empirical chapter is the following:

$$Q_\tau\,(wq_i) = \beta_0 + S_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + \varepsilon_i \qquad (5.5)$$

where wq is the weekly quantity of breakfast cereal purchases, τ denotes the τ-th quantile in the distribution of household breakfast cereal purchases.

S_i is the vector of all socio-economic household characteristics including *age, gender, number of adults, number of children, SIMD and accessibility;*

P_i is the vector of all product characteristics including the *proportions of purchases under price and volume promotions* as well as *healthy* and *branded* products, and also logarithms of the *weight* per package and the *full price* of healthy and less healthy products;

Z_i is the vector of all shop characteristics including where purchases have been made across shop types, namely the *proportion of purchases made in discounters*;
ε_i is the standard error term.

The model utilised the logarithm of the dependent variable wq and three independent variables (weight of the package, full price of the healthy products (per 100g), full price of the less healthy products (per 100g)) to estimate elasticities.

Weighted average is a calculation that considers the varying degrees of importance of the numbers in the given data set. Each number in the data set is multiplied by a predetermined weight (in this study a weighted product and weighted shop factor) before the final calculation is made. In doing this, the weighted average is more accurate than a simple average in which all numbers in a data set are given the same weight before summing them to a sole average value. Product and shop characteristics have been weighted due to the fact that the data was collapsed by household. Through using the frequency of how often a household purchased certain products across the year gave importance to the products that have been bought more frequent than others and therefore product characteristics are weighted averages. The same has been done for shop characteristics where households have been purchasing most through including the frequency and therefore stressing the importance of the shops where the household purchased more products than in others.

Further, the study includes proportions of values because the findings reflect the proportion purchased by households, which followed from collapsing the purchase data set by household level. For instance, all promotional variables are expressed in proportions. It can also be described also as percentages of purchases for example, out of 100% of household's purchases on average 0.63 (63%) have been bought under no promotion and 0.29 (29%) price promotion and 0.07 (7%) under volume promotion. The same applies for branded and private label products and the proportions of purchases made across supermarket types. Normal units of measurements are all socio-economic characteristics such as gender or number of adults as the data is household-level data. Table 5.4. mentions for each variable indicating whether it is a logarithm, a proportion and normal units of measurement.

It is important to highlight that the promotion variables are measuring the proportion of a household's breakfast cereal purchases that are on promotion and examining whether a relationship for households who buy more of their breakfast cereals on price and volume promotion tend to purchase more exist. This analysis provides contextual information on what factors influence the amount of purchases including promotion types and the independent variable groups are treated like control variables to better estimate the main effects of promotions. Based on the literature review, the study will focus on the health and brand status of the products as well as the package size, and a few key socio-economic characteristics. However, most coefficients of the control variables have a straightforward interpretation such as larger households generally purchase more of everything which

includes breakfast cereals. In more detail the models are constructed in the following way and are described in Table 5.4:

Baseline model (model 1):

$$Log\ (wq) = a_0 + \beta_1 * SEX_i + \beta_2 * AGE_i + \beta_3 * AD_i + \beta_4 * CH_i + \beta_5 * SIMD1_i + \beta_6 * SIMD2_i + \beta_7 * SIMD3_i + \beta_8 * SIMD4_i + \beta_9 * RURAL_i + \beta_{10} * PP_i + \beta_{11} * VP_i + \beta_{12} * H_i + \beta_{13} * BRAND_i + \beta_{14} * \log(WEIGHT)_i + \beta_{15} * \log(FP\_H)_i + \beta_{16} * \log(FP\_LH)_i + \beta_{17} * DIS_i + \varepsilon_i \quad (5.6)$$

In order to address the research question in more detail, two terms have been added to the model 1, which are interaction terms based on price promotions and healthy products purchased ($PP * H$) and also volume promotion and healthy products purchased ($VP * H$). This is justified by investigating the research question further looking at RQ2b) to answer the question whether households are more susceptible to promotions on healthy products and whether there is a difference between price and volume promotion to the household's responsiveness. The model with interaction terms aims to isolate the effect of each promotion type across healthy purchases through the estimated interaction terms and will therefore give insights on the responsiveness to households. The added interaction terms try to isolate the effect of promotions on healthy products only to answer the research question, whether there exists a difference between price and volume promotion to the household's responsiveness across the healthiness of products.

Interaction model (model 2):

$$Log\ (wq) = a_0 + \beta_1 * SEX_i + \beta_2 * AGE_i + \beta_3 * AD_i + \beta_4 * CH_i + \beta_5 * SIMD1_i + \beta_6 * SIMD2_i + \beta_7 * SIMD3_i + \beta_8 * SIMD4_i + \beta_9 * RURAL_i + \beta_{10} * PP_i + \beta_{11} * VP_i + \beta_{12} * H_i + \beta_{10} * PP * H_i + \beta_{11} * VP * H_i + \beta_{13} * BRAND_i + \beta_{14} * \log(WEIGHT)_i + \beta_{15} * \log(FP\_H)_i + \beta_{16} * \log(FP\_LH)_i + \beta_{17} * DIS_i + \varepsilon_i \quad (5.7)$$

5.3.3. Data description of household consumption

This chapter examines the relationship of the variables in the econometric models as specified in the preceding sections. It will also report and analyse the results obtained from the descriptive statistics to achieve the research objectives. First of all, the chapter presents discussions of the descriptive statistics of the variables in the model while ensuring that the statistical assumptions are adhered to. The first step in achieving the stated objectives is to explore the descriptive statistics to help analyse the data from a preliminary viewpoint. Descriptive statistics are the statistical procedures used in organising and

describing the characteristics of the data, which is analysed in the following section. These statistics help to describe the measures of central tendency and the measures of variability of the data presented.

The dataset provided by Kantar Worldpanel includes a sample size of around 2,750 household panellists and is of sufficient size and representation to reflect the Scottish population in terms of their Scottish take home purchases providing a robust retail purchase dataset. The unit of observations is the household and their average quantity of breakfast cereals purchased during the year 2015. It is important to highlight that the product and shop variables are proportions as the data has been collapsed by household and therefore most product and shop characteristics are proportions across all purchases of each household in 2015. Table 5.4 presents the variables used in the analysis and their description.

Table 5.4 Description of the choice of variables employed in the analysis.

	Variables	**Measures/ Description**
Dependent variable		
log(wq)	Weekly quantity purchased	Average weekly quantity purchased by household (The annual quantity purchased of breakfast cereal products divided by the number of weeks that the household was in the sample in 2015) (log)
Socio-economic household characteristics		
AGE	Age	Age of the principal shopper
SEX	Gender	Gender of the principal shopper Dummy variable:1 = female; 0 otherwise
AD	Number of adults	Number of adults in the household
CH	Number of children	Number of children in the household
SIMD	Scottish Index of Multiple Deprivation	Dummy variable: 1 = SIMD 1 (most deprived); 0 otherwise Dummy variable: 1 = SIMD 2; 0 otherwise Dummy variable: 1 = SIMD 3; 0 otherwise Dummy variable: 1 = SIMD 4; 0 otherwise Dummy variable: 1 = SIMD 5 (least deprived); 0 otherwise) (used as reference category)
RURAL	Rural accessibility	Dummy variable: 1 = Rural; 0 otherwise
QUANTITY	Quantity purchased	Weekly quantity purchased by household (in model 3)
Product characteristics (weighted)		
PP	Prop. Price promotion	Proportion of total purchases made under price reduction promotion
VP	Prop. Volume promotion	Proportion of total purchases made under “multi-buy” and “x for £y” promotion of total purchases
H	Prop. FSA Healthy	Proportion of purchases that were healthy products in comparison to less healthy products (based on the UK FSA score) – calculated from dummy
BRAND	Prop. Branded label	Proportion of purchases that were branded products (in comparison to private label) – calculated from dummy
log(Weight)	Weight	Mean weight of the products purchased in gram (log)
log(FP_H)	Full price healthy products	Mean full price of the healthy products (per 100g) purchased of all weekly prices in 2015 in GBP (before e.g. a promotion was applied) (log)

log(FP_LH)	Full price less healthy products	Mean full price of the less healthy products (per 100g) purchased of all weekly prices in 2015 in GBP (before e.g. a promotion was applied) (log)
Shop characteristics (weighted)		
DIS	Prop. Discounter	Proportion of product purchased in a discounter compared to all other supermarket types All others include: Major supermarket brands; Convenience formats of main retailers; Internet retailers; Discount supermarkets; Corner shops and other local shops; Other shops
Interaction terms added in model 2		
PP*H		Interaction term: Proportion price promotion purchased and proportion healthy products purchased
VP*H		Interaction term: Proportion volume promotion purchased and proportion healthy products purchased

Socio-economic household characteristics across household consumption

The following section illustrates different patterns in the data from a descriptive point, for instance providing an overview of the distribution of purchases across health and brand status, the distribution of promotion types and where the purchases have been made across shop types. Table 5.5 describes the maximum and minimum and means across different cuts of the dataset for several socio-economic characteristics. It compares the mean of all households, lower breakfast cereal consumers and higher breakfast cereal consumers and is defined and split by the mean of weekly purchases made.

Table 5.5 Descriptive statistics of socio-economic characteristics by consumption.

			All households	**Low consumption households**	**High consumption households**
Observations			2705	1681	1024
Variable	Min	Max	Mean	Mean	Mean
Weekly quantity purchased	.019	5.233	.564	.260	1.061
Female principal shopper	0	1	.744	.721	.782
Age of principal shopper	18	89	48.206	49.148	46.659
Number of adults	1	6	2.037	1.949	2.182
Number of children	0	6	.580	.405	.868
Average income in £	5,000	70,000	29,765.25	28,726.948	31,469.727
SIMD 1	0	1	.193	.210	.166
SIMD 2	0	1	.218	.229	.201
SIMD 3	0	1	.209	.206	.213
SIMD 4	0	1	.211	.198	.232
SIMD 5	0	1	.169	.157	.188
Rural accessibility	0	1	.220	.199	.254

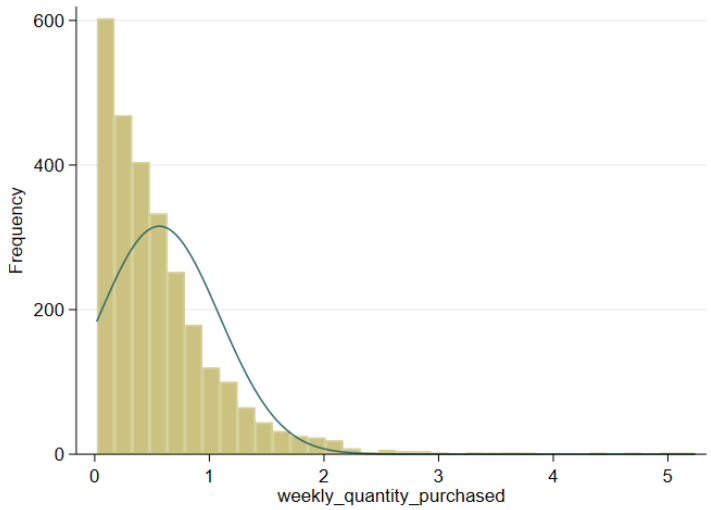
Table 5.5 highlights key summary statistics of household characteristics. Overall, 74% of households have a female main shopper aged on average 48 years old and the average household comprises of about 2 adults live in a household with 0.58 children. The average household earns £29,765 per annum and

the accessibility of 22% of households is categorised as rural (compared to urban). The SIMD classification from SIMD 1 (most deprived) to SIMD 5 (least deprived) is relatively equally distributed among the five groups ranging from 17 to 22% across the groups. Dividing the consumers into low and high purchase/consumption groups split by the mean of weekly purchases, categorise 1,681 households for lower and 1,024 households for higher consumption. Low consumption households have an older principal shopper (49 years compared to 46 years old), and a smaller family including the number of adults and children on average. The average income is £28,726 among lower consumers living in 20% rural areas whereas the higher group earns £31,469 on average and 25% live in rural areas.

Weekly quantity purchased by households (dependent variable)

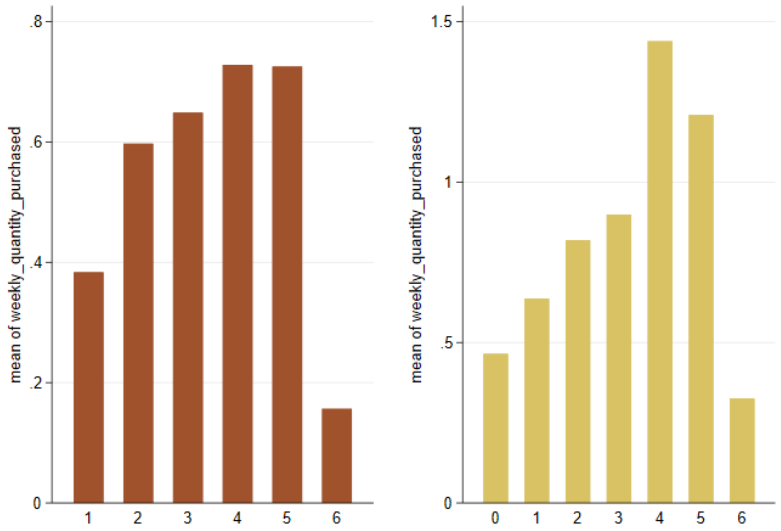
The variable of interest in this analysis is the average weekly quantity of breakfast cereals purchased by a household in 2015. The distribution is visualised in a histogram in Figure 5.2. It is computed through the annual purchase for consumption at home made in 2015 for each household divided by the weeks that a household participated in the Kantar Worldpanel sample in the year 2015. It will be interpreted as the "consumption" even though they are simply purchases made by households.

Figure 5.2 Distribution curve of dependent variable "weekly quantity purchased".



Further, the histogram in Figure 5.3 supports the findings from the table that the weekly quantity purchased obviously increases with the member of the household by adults and children highlighting the importance of the breakfast cereal healthiness linked with the role of families. From a descriptive perspective in Table 5.6, the data shows that a household purchases 0.564 packages in a week on average across all 2,705 breakfast cereal households. However, it ranges from the minimum of 0.019 to a maximum of 5.233 packages.

Figure 5.3 Histogram of weekly quantity purchased across measures of household size.



Number of adults (left) vs. number of children (right) in the household

Product characteristics across household consumption

Table 5.6 below describes the maximum and minimum and means across different cuts of the dataset for several product characteristics comparing low and high breakfast cereal consumers.

Table 5.6 Descriptive statistics of product characteristics by consumption.

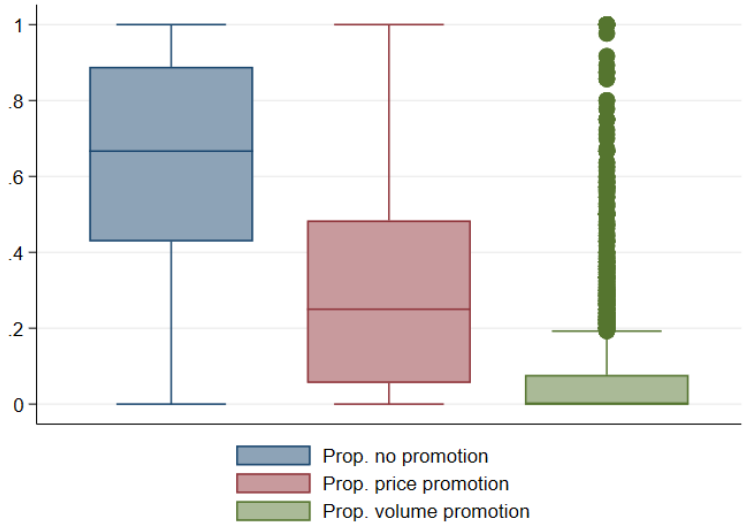
			All households	**Low consumption households**	**High consumption households**
Observations			2705	1681	1024
Variable	Min	Max	Mean	Mean	Mean
Prop. label private	0	1	.382	.350	.433
Prop. label branded	0	1	.618	.650	.567
Adds up to one			1	1	1
Prop. No promotion	0	1	.630	.639	.615
Prop. Price promotion	0	1	.298	.298	.299
Prop. Volume promotion	0	1	.071	.063	.086
Adds up to one			1	1	1
UK FSA (not weighted)	-6	11	-.099	-.272	.185
UK FSA	-6	11	-.091	-.147	0
Weight pack	28.6	2000	571.181	571.625	570.451
Full price 100g					
Note: Weighted values are reported					

The product characteristics show that on average 61% of all purchases are branded products, purchases under no promotion are 63%, price promotion about 30% and 7% are volume promotion. Looking at the healthiness across these purchases, the average UK FSA score is -0.099 ranging from -6 to 11 (healthiest to unhealthiest), however the analysis will only make use of the weighted average UK FSA

score. Further, the Table 5.6 shows that on average 65% of purchases by low-consuming households are on branded products whereas for high-consuming households it is 56% and therefore more private labels. No large differences in the role of promotion, besides low-consuming households purchase more under no promotion and less under volume promotion.

Another tool to describe data, is the box plot revealing a "five statistical summary" of the data set, and dividing the data into quarters showing horizontally from left to right (or vertically bottom to top) on the diagram: minimum, first quartile (Q1), median (Q2), third quartile (Q3), and maximum. Outliers are shown as a separate dot. A boxplot is a standardized way of displaying the distribution of data and can also tell whether the data is symmetrical, how tightly the data is grouped, and if and how the data is skewed. Figure 5.4 shows the proportion of purchases made under promotion types included in this study. It compares for instance the median of purchases made under each promotion type; under no promotion are 66%, price promotion account for 28% and 6% for volume promotion. However, it highlights that there are household across the full range purchasing for instance 100% under no promotion but also some households purchased 100% under price promotion.

Figure 5.4 Proportion of purchases made under promotion types across households.

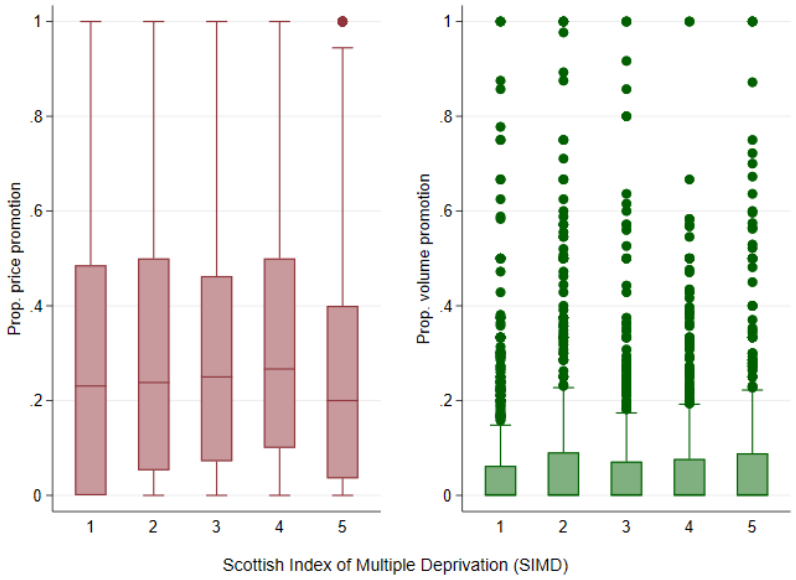


Linking purchases made under promotion types with household characteristics

Another important household variable is the SIMD which is the level of deprivation among household in Scotland. As mentioned earlier, key variables in this study are the deprivation level of households and also the promotion types across products purchased. Figure 5.5 exhibits the link between the two; the proportion of purchases made under price promotion and volume promotion across the five SIMD categories in two boxplots comparing across five statistics the distribution of data (the dots indicating outliers due to a lack of data across volume promotions divided further across SIMD categories). It shows that the level of deprivation does not influence the proportion of products purchased under each

promotion to a great extent. Although the differences were small, in 2015 households living in the most deprived areas (SIMD 1) purchased a greater proportion of their breakfast cereals under price promotion compared to the least deprived areas (SIMD 5).

Figure 5.5 Price and volume promotion purchases by SIMD categories.



Shop characteristics across household consumption

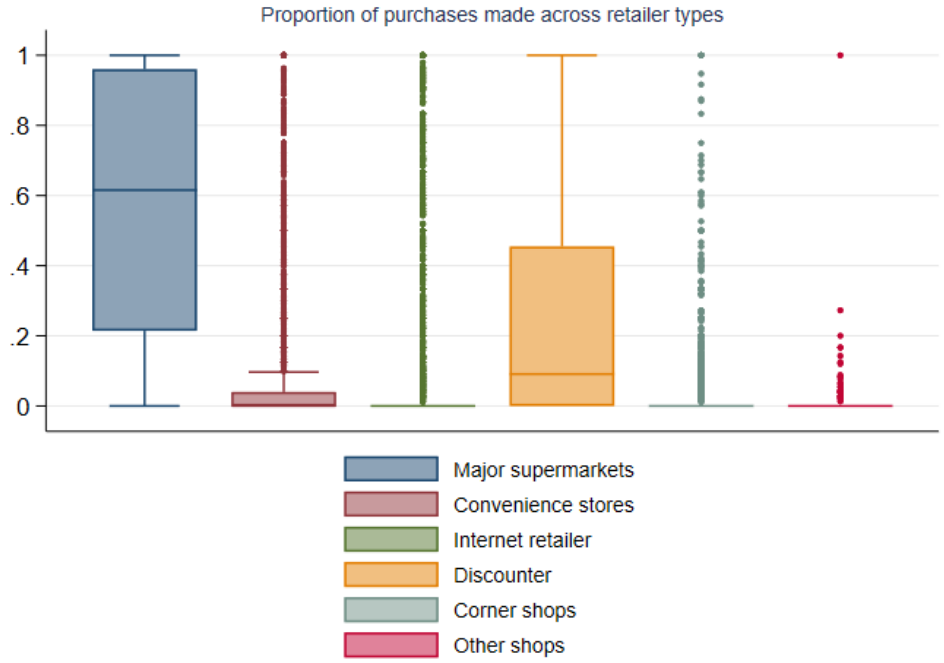
Table 5.7 below describes the maximum and minimum and means across different cuts of the dataset for the shop characteristics including a comparison of lower and higher breakfast cereal consumers. The shop information gives insights to where the consumers shop on average; 56% in major supermarket, 9% in convenience stores, 7% with online retailers, 25% in discounters and 3% in other shops. It also shows that high consumption households, purchase less in major supermarkets and convenience stores but a greater proportion in discounters compared to the other subgroups.

Table 5.7 Descriptive statistics of shop characteristics by consumption.

			All households	**Low consumption households**	**High consumption households**
Observations			2705	1681	1024
	Min	Max	Mean	Mean	Mean
Major supermarkets	0	1	.564	.567	.558
Convenience stores	0	1	.093	.102	.077
Internet retail	0	1	.066	.057	.082
Discounter	0	1	.254	.249	.262
Corner shops	0	1	.022	.024	.019
Other shops	0	1	.001	.001	.001
Adds up to one			1	1	1
Note: Weighted values are reported					

What stands out in one glance in Figure 5.6. is that the main shops where consumers buy breakfast cereals are major supermarket chains (56%) and discounters (25%), followed convenience stores (9%).

Figure 5.6 Boxplot of proportion of household purchases across retailer types.



5.4. Empirical results

The results obtained and presented in this chapter are analysed comprehensively to help understand the relationship between breakfast cereal purchases and the influence of retail promotion types across weekly breakfast cereal purchases of 2015. This chapter is giving contextual information about the purchase behaviour measured in the quantity purchased by each household. Stressing the fact that this analysis focusses on factors that are associated with breakfast cereal purchases, in particular regarding the relationships between different retail promotion types and particularly whether these promotional effects differ by the healthiness of the products. It will further present evidence to establish the different effect across promotion types on purchases made by households. Also, the results indicating a relationship between the level of deprivation and purchases under promotions linked to healthiness of breakfast cereals are discussed in this chapter. The final part discusses the robustness test results which indicate the extensiveness and originality of this research.

To recap, caveat on key issues about the results and interpretation of the data: This study only looks at parts of consumers purchases. It analyses breakfast food products, which are all part of the food category breakfast cereals. They include subcategories such as porridge oats, ready-to-eat-cereals,

granola, muesli and instant porridge. Through this, the study approaches the demand side of the data through household purchases aggregated by household level. Moreover, the Scanner data offers the advantage of a detailed range of datasets, but also it has to be highlighted that the data are not equivalent to food intake or consumption but is best described as 'purchases made'. In this chapter, the term 'consumption' should thence be interpreted as purchases made by the households, as an approximation of food consumption as it has been bought to be eaten at home. Further, the dataset and the use of a quantile regression model works across the full distribution and therefore with extremes of the data. This implicates that less data is found at the ends of distribution and therefore to some extend highlights a lack of data. This is important for the data interpretation used in the result section.

The study examines the influence of several factors on breakfast cereals purchased by consumers focusing on purchases made under different promotion types giving contextual information about the purchase behaviour measured in the quantity purchased by each household. Moreover, it includes the impact of the healthiness of products on the purchases but also highlights further interesting findings that impact the purchase behaviour of consumers. The study examines the influence of socio-economic household characteristics, product characteristics and shop characteristics on the weekly quantity purchased in 2015 across different quantiles. The model estimates coefficients for the 10th, 25th, 50th, 75th and 90th quantiles. The results help to determine how the variation in predictors affects breakfast cereal purchases in the tails of the distribution and indicate the household's characteristics that lead to less or more breakfast cereal consumption. The data represents the proportion of a household's breakfast cereal purchases that are on promotion and therefore the analysis is not testing the effect of discounting on households directly but whether there is a tendency for households who buy more of their breakfast cereals on price and volume promotion tend to buy more products. So, while there is an expectation that households that buy breakfast cereal on promotion may buy more than those that buy relatively little of their breakfast cereals on promotion the model is not able to test the discounting effect on household behaviour directly. That is why this analysis is described as a contextual information on what factor influence the amount of purchases and the following chapter will look into more detail analysing how promotions influence the healthiness of household purchases.

The study employs OLS regression and quantile regression to analyse the determinants of weekly breakfast cereal purchases for different consumption levels in Scotland. In this study, the quantile regression provides estimates of the influence of the socio-economic characteristics on the quantity of breakfast cereals purchased by households. It shows the influence of a covariate (i.e., socio-economic characteristics or proportion of price promotions purchased) at various quantiles of the full distribution (Q.1, .25, .5, .75, .9) on the depended variable (the quantity purchased of breakfast cereals). The quantiles can be chosen based on the various criteria such as the amount of observations (Koenker and Hallock 2001). The empirical results from the quantile regression and OLS are presented in Table 5.9. Due to the number of independent variables in this study, they have been categorised across three

groups of parameters to group the variables easier: product characteristics, household characteristics and shop information. The following variables have been used in this study. The results will be explained across themes and parameter groups (Table 5.8).

Table 5.8 Detailed parameter groups applied in the analysis (Chapter 5).

Dependent variable	**Weekly quantity of breakfast cereal purchases**
Parameter group	Included variables
Product characteristics (weighted)	Proportion purchased under price promotion
	Proportion purchased under volume promotion
	Proportion purchased with FSA "Healthy"
	Proportion purchased with a branded label
	Weight per pack (log)
	Full price per 100g healthy (log)
	Full price per 100g less healthy (log)
Socio-economic household characteristics	Age of principal shopper
	Gender of principal shopper
	Number of adults
	Number of children
	Scottish Index of Multiple Deprivation (SIMD)
	Rural aaccessibility
Shop characteristics (weighted)	Proportion purchased in shop "discounter"

Overall, the results and the interpretation of them will be used to answer the research question on what influences the consumption of breakfast cereals and which factors increase and which decrease the quantity purchased. Applying the quantile regression, it models associations between independent and dependent variables at different points of the distribution of a continuous variable rather than just the mean in the OLS model. The results of the OLS and QR will be explained along the following themes:

(i) consumption by promotion types

(ii) consumption by healthiness of breakfast cereals

(iii) consumption across interesting dimensions among three parameter groups

(1) Socio-economic background of households

(2) Product information

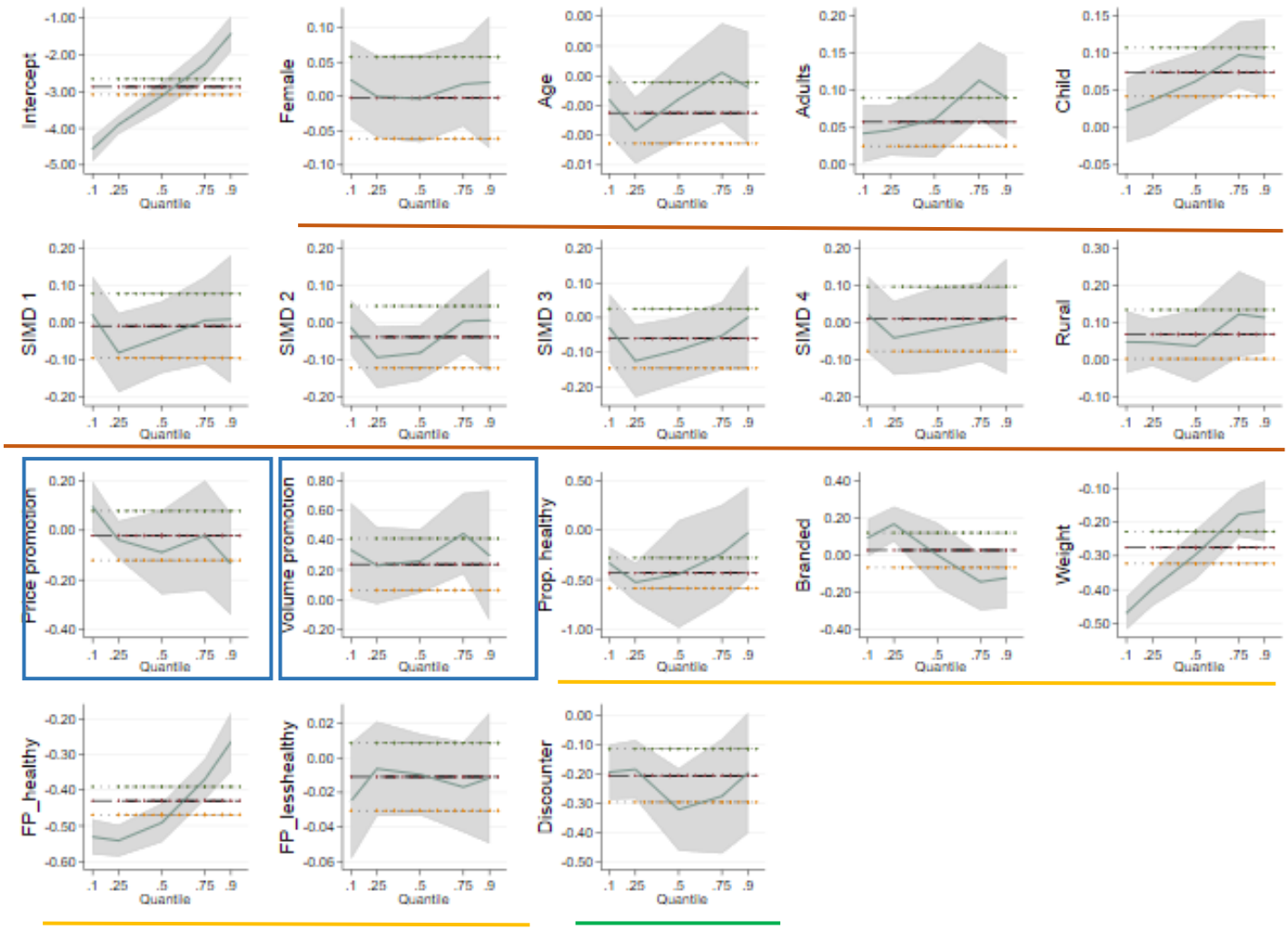
(3) Shop characteristics

The focus and contribution of this study lies on (i) and (ii) but will highlight briefly further interesting findings such as the level of deprivation of the household and the health and brand status of a product. However, the graph (Figure 5.7) and coefficients (Table 5.9) will be presenting all independent variables stressing the importance to include several control variables across the full

distribution that is offered by the quantile regression. Two models will be applied to answer the research question in full detail as to address the second part of the analysis it included interaction terms so the results will be based on two models. This leads to measuring the variables and their construction the following way: The first model measures the association between household purchases and the proportion of household purchases that are made under each promotion type (price and volume promotion). Whereas the second model measures the association between household purchases and several characteristics but also includes interaction terms to be able to investigate the responsiveness of household on promotions linked to the health status of purchases. The nature of the data allows to link consumer purchases to socio-economic characteristics of households. Attention must be paid to the fact that all product and shop information have been collapsed by households giving a weighted average across the year. For example, in this analysis the promotion variables are proportions of products purchased under a certain promotion type across all purchases made by each household.

Figure 5.7, which includes both the OLS estimates and the quantile regression, supports the observation of Mosteller and Tukey (1977), quoted by Koenker and Hallock (2001), that by focusing only on the conditional mean in the least-squares regression gives an incomplete summary of the joint distribution of dependent and explanatory variables. Figure 5.7 presents for each percentile the coefficients and confidence intervals directly to the OLS results. The solid black line is the least squares estimate, and the dotted lines show the confidence interval of the OLS results. The QR results for the quantile indicated on the x axis is shown by the green line and the grey shadow around it is the confidence interval of the QR result. The first two rows of the graph deal with the household characteristics and their influence on the weekly quantity of breakfast cereals purchased, the third row as well as the first two boxes of the fourth row include product information, and the last box includes shop information. A colour coding scheme is applied across the parameter groups to help understand the individual factors. The inspection of the Figure 5.7 thus helps to underline the importance to not only look at the mean distribution but include the full distribution. Therefore, the following section will explain the OLS results first and then highlight the difference that the Quantile Regression results will reveal.

Figure 5.7 Trends of quantile regression estimates in baseline model.



Colour coding scheme

Retail promotion type information

Socio-economic household characteristics

Product characteristics

Shop characteristics

The quantile regressions estimated the associations between quantity purchased and different characteristics at the 10th, 25th, 50th, 75th, and 90th percentiles with robust SEs. The coefficient reported for each quantile are β values and are interpreted in the same way as in ordinary least squares regression (Hobbs and King 2018). All results need to be interpreted against the assumption that in the model all other independent variables are held constant. Table 5.9 presents the estimation results from the OLS and quantile regression. Results are discussed by promotion type, by product healthiness, and

includes further interesting dimensions across all three parameter groups. The full table has been presented however only key results will be addressed according to the research questions and explained by themes.

The dependent variable is the weekly quantity of breakfast cereals purchased by households computed through the annual breakfast cereal purchases made by households divided by the number of weeks that the household was in the sample. The range can therefore be interpreted as the least quantity purchased up to the most quantity purchased indicating irregular breakfast cereal consumers compared to the other extreme of frequent eaters including breakfast cereal as a fixed part in their diet. The following sections will describe the results of the OLS and QR results, which are divided into groups among all households:

OLS – mean purchases
Q10 (10^{th} percentile) – lowest purchases
Q25 (25^{th} percentile) – low purchases
Q50 (50^{th} percentile) – median purchases
Q75 (75^{th} percentile) – high purchases
Q90 (90^{th} percentile) – highest purchases

Table 5.9 OLS and QR estimates in baseline model.

	OLS	Quantile Regression				
		Q10	**Q25**	**Q50**	**Q75**	**Q90**
	Mean purchases	Lowest purchases	Low purchases	Median purchases	High purchases	Highest purchases
Household characteristics						
Female principal shopper	-0.00204 (0.03034)	0.02377 (0.0318)	-0.00012 (0.02078)	-0.00328 (0.02348)	0.01802 (0.03823)	0.02048 (0.04185)
Age of principal shopper	-0.0025** (0.00105)	-0.00164** (0.00079)	-0.00368*** (0.0011)	-0.00157* (0.00094)	0.00021 (0.00133)	-0.00076 (0.0026)
Number of adults	0.05796*** (0.01656)	0.0425* (0.02274)	0.04668** (0.02115)	0.0614*** (0.02306)	0.11381*** (0.02889)	0.09065*** (0.03233)
Number of children	0.07504*** (0.01673)	0.02352 (0.01658)	0.03718* (0.01935)	0.06254*** (0.02069)	0.09826*** (0.01696)	0.09398*** (0.02315)
SIMD 1	-0.00839 (0.0441)	0.02077 (0.051)	-0.08039* (0.0442)	-0.03881 (0.0364)	0.00663 (0.04385)	0.00965 (0.07243)
SIMD 2	-0.03834 (0.04253)	-0.01299 (0.05158)	-0.09305*** (0.03445)	-0.08094** (0.03495)	0.00414 (0.05876)	0.00694 (0.06027)
SIMD 3	-0.06056 (0.04368)	-0.02984 (0.0373)	-0.12517*** (0.03782)	-0.09407** (0.04076)	-0.05271 (0.05461)	0.00048 (0.06692)
SIMD 4	0.01036 (0.0442)	0.02185 (0.04526)	-0.04059 (0.03371)	-0.01798 (0.02838)	0.00138 (0.0547)	0.01773 (0.06536)
Rural accessibility	0.06906** (0.03362)	0.04844* (0.02808)	0.04736 (0.03344)	0.03762 (0.02771)	0.12342*** (0.03505)	0.11411** (0.04953)
Product characteristics (all weighted and all proportions except weight and full price)						
Prop. Promo Price	-0.02082 (0.0509)	0.09584** (0.03816)	-0.03825 (0.04948)	-0.08869 (0.07869)	-0.02035 (0.10183)	-0.13584 (0.10348)
Prop. Promo Volume	0.23676*** (0.08867)	0.33274*** (0.11658)	0.22876** (0.1127)	0.25896* (0.13851)	0.44384*** (0.15685)	0.29511 (0.22355)
Prop. Healthy	-0.43305*** (0.07824)	-0.33473*** (0.09648)	-0.52629*** (0.10484)	-0.44342** (0.20485)	-0.23618 (0.16413)	-0.02892 (0.22607)
Prop. Branded	0.02554 (0.04774)	0.09243** (0.04618)	0.16602*** (0.03146)	-0.00002 (0.06079)	-0.14514*** (0.04574)	-0.12415* (0.07239)
Log Weight per pack	-0.27527*** (0.02417)	-0.4695*** (0.03118)	-0.39729*** (0.0245)	-0.29618*** (0.03789)	-0.1764*** (0.04155)	-0.16632*** (0.04473)
Log Full price healthy (100g)	-0.42947*** (0.02015)	-0.53111*** (0.02687)	-0.54168*** (0.02759)	-0.49134*** (0.03798)	-0.36883*** (0.03321)	-0.26449*** (0.04655)
Log Full price less healthy (100g)	-0.01094 (0.01001)	-0.02502* (0.01296)	-0.00624 (0.01323)	-0.0096 (0.01466)	-0.01688 (0.01248)	-0.01164 (0.01421)
Shop characteristics (weighted and proportion)						
Prop. Discounter (w)	-0.20638*** (0.0464)	-0.19462*** (0.05559)	-0.18557*** (0.05673)	-0.32266*** (0.09983)	-0.27701*** (0.06904)	-0.19746** (0.08285)
Constant	-2.8735*** (0.10865)	-4.56316*** (0.14461)	-3.90232*** (0.09299)	-3.12398*** (0.12376)	-2.24658*** (0.12182)	-1.43204*** (0.18887)

Note:
The signs (***), (**) and (*) denote significance at 1%, 5% and 10% level respectively. Robust standard errors are presented in parentheses. All test results are not significant unless indicated otherwise through colouring underlining significant coefficients at one glance.

5.4.1. Consumption by retail promotion types

Price is a critical influence on food purchase decisions made by consumers in the retail environment, and, therefore, retail promotions are likely to be a crucial factor influencing dietary patterns and also the quantity purchased in a week of breakfast cereals. As retail promotions change the price of a good, the analysis shows that price and volume promotions influence the household's purchases of breakfast cereals. To recap, this model measures the proportion of a household's breakfast cereal purchases that have been made under each promotion type and therefore it shows whether there is a tendency for households who buy more of their breakfast cereals on price or volume promotion tend to buy more products.

(i) Promotion types: Do price promotions influence breakfast cereal purchases differently compared to volume promotions?

Promotional purchases with a price promotion

In the OLS model, the coefficient on the proportions purchased under price promotion is not significant (compared to no promotion). The QR result offers further insights among the distribution and shows that it is positively significant for the lowest purchases (10^{th} percentile). A one percent increase in the proportion of price promotions purchased only impacts the lowest quantile increasing the weekly quantity by 0.09 percent. An increase in products purchased under price promotion increases the weekly quantity purchased for the low consumption households indicating that a price promotion might encourage consumers to experiment more – as it offers a discount of the regular full price and is not linked to a condition to purchase more packages of a product that they might not like. However, it seems not to affect the weekly quantity among low to the highest purchasing household (Q25 Q50 Q75 and Q90) indicating that they purchase anyways regardless of a price promotion. This reveals that households who buy more of their breakfast cereals on price promotion tend not to buy more products except for the lowest consuming household.

One way of interpreting the coefficients is that the results indicate that price promotions make no difference in the quantity purchased whether they purchase a lot or a little under promotion. Households purchase the same amount of products regardless of how much of their purchases are under promotion or no promotion at all. In other words, no association between how much a household purchases and the proportion of products purchased under price promotion has been found. It could be interpreted that household that buying all their products with a price reduction and the households that buy nothing under a price promotion purchase the same quantity in a week, meaning they buy them but simply do not increase the quantity due to a promotion. However, it does not implicate that price promotions are no successful tool for retailers, it just has to be highlighted that a feature of the data relates only to the proportion of promotional purchases made with a price reduction.

Another reason could be that household do not increase the quantity (purchase an additional pack) but rather spend the "saved" money on other products. This is called cross-category promotion effects. Retailers can benefit from this effect due to the impact of price promotions on category demand or other categories (cross-category or cross-promotion effects). (Ailawadi et al. 2006).

Further, the results might conclude that promotions come up frequently and that consumers, instead of stocking up on bulky breakfast cereal boxes, prefer to wait for a later shopping trip to purchase the product again when needed.

Promotional purchases with a volume promotion

The estimates of the proportion for purchases made under volume promotion are significantly positive across the OLS and almost all quantiles (except for the households that purchase highest quantity) and shows that an increase in the proportion of products purchased under volume promotion increases the weekly quantity purchased. However, this result was expected as a volume promotion is linked to the condition to purchase more packages such as a "buy one get one free offer". An increase in the products purchased with volume promotion, increases the weekly quantity bought. This result is intuitive as a volume promotion such as a buy-one-get-one-free is linked to an increased number of products automatically to receive the offer. For the OLS result, a one percent increase in the proportion of volume promotions purchased, increases the weekly quantity by 0.23 percent. The QR gives more details across the distribution - the households that have a high weekly consumption of breakfast cereals, have a high increase in the volume promotion purchases (from Q10 0.33 percent to 0.44 percent for Q75).

Comparing this result to price promotions, where no difference in the weekly quantity purchased has been found as the promotional purchases increase, the volume promotion variable indicates that there is a difference in the number of products purchased. In other words, volume promotions increase the quantity across the full range of households, which is obviously part of the deal. The promotion type links the promotion to the number of products meaning that with a multi-buy several packages need to be purchased. It needs to be acknowledged that consumers usually know what type of product they buy under volume promotion and they include breakfast cereals as part of the regular diet whereas a price promotion offers an opportunity to experiment with an unfamiliar product. Overall, it has to be taken into consideration that this food category is linked to large and bulky packages which not always are desired buy consumers due to the difficulty to transport and store them.

Price promotions do not encourage consumers to purchase more of a product, but this leads to the question whether the same response is found across healthy and less healthy products? Does it make a difference whether a promotion is applied to a healthy breakfast cereal? Does it change the purchase behaviour?

5.4.2. Consumption by healthiness of breakfast cereals

The contextual information in this chapter gives insights about the healthiness of product and how it influences the purchases, but also examines the responsiveness of consumers towards the type of retail promotion impacting purchases on healthy and unhealthy products differently. The UK FSA Nutrient Profiling Score defines the healthiness of the products across the purchases that have been made across the year. However, in this analysis through collapsing the data by household, it gives the average weighted UK FSA Score across all purchases made by the household. For simplification, the author also refers to an "index of unhealthy purchases" – because the higher the UK FSA score the less healthy the breakfast cereal purchases per household across the year.

(ii) Does the healthiness of a product influence purchases? Are households more susceptible to promotions on healthy products? Is there a difference between price and volume promotion to the household's responsiveness across healthiness of products?

Before interpreting the results of Model 2 including the interaction terms, another coefficient from Table 5.9 deserves attention. To describe the healthiness of products in this study, the UK FSA Nutrient Profiling score has been applied to each product and each household has been assigned an individual average weighted UK FSA score based on the products that they bought over the year. This variable measures the proportion of healthy products purchased and has been found significantly negative for OLS and Q10 and Q25 and Q50. For the mean purchasing household the weekly quantity decreases by 0.43 percent compared to 0.33 percent for the lowest purchasing households and 0.52 percent for the low purchasing households and 0.44 percent for the median purchase households. In other words, the more healthy products are purchased in a household, the less products they purchase in a week.

To answer the research question fully with regard to the health status and the impact of promotion type two interaction terms have been added into a second model, called the "interaction model", specifically, addressing whether the type of retail promotion impacts on purchases on healthy and unhealthy products differently. Having found in the first model that retail promotions encourage purchases, the question arises whether the same responsiveness is found across healthy and less healthy products. The interaction model includes two interaction terms, measuring the additional effect based on the proportion of promotion purchase and proportion of healthy purchases addressed, which results from the nature of the data by aggregating at household level. Interpretation of the result can be done in terms of elasticities for the independent variables as they are proportions or log of independent variables, therefore a one percent change in the proportion, is the percent change in the quantity purchased. For the socio-economic factors there are no proportions or logs and therefore interpreted normal. Overall, it needs to be highlighted that the model gives associations and no causal relationships.

Table 5.10 OLS and QR estimates in interaction model.

	OLS	Quantile Regression				
		0.1	**0.25**	**0.5**	**0.75**	**0.9**
	Mean purchases	Lowest purchases	Low purchases	Median purchases	High purchases	Highest purchases
Prop. Promo Price	-0.06694 (0.06826)	0.00997 (0.08442)	-0.11314* (0.05823)	-0.15643** (0.07428)	-0.09466 (0.09599)	-0.0912 (0.12322)
Prop. Promo Volume	0.18288 (0.11996)	0.15341 (0.13002)	0.12163 (0.12913)	0.17835 (0.1381)	0.50403*** (0.1536)	.57596** (0.28108)
Prop. Healthy	-0.4773*** (0.08772)	-0.37638*** (0.09988)	-0.66894*** (0.12078)	-0.53049*** (0.16613)	-0.28788* (0.16151)	0.06504 (0.29938)
Interaction price promo*healthy purchases	**0.1429 (0.14074)**	**0.1463 (0.12747)**	**0.30364** (0.13456)**	**0.53971 (0.34422)**	**0.27899 (0.36621)**	**-0.12656 (0.40748)**
Interaction volume promo*healthy purchases	**0.18344 (0.28836)**	**0.48704** (0.24188)**	**0.4944 (0.40056)**	**0.41069 (0.30244)**	**-0.47777 (0.39775)**	**-0.7784 (1.44118)**

The signs (***), (**) and (*) denote significance at 1%, 5% and 10% level respectively. Robust standard errors are presented in parentheses. All test results are not significant unless indicated otherwise through colouring underlining significant coefficients at one glance.

Do the promotional effects differ by the health status of the breakfast cereals purchased?

New interpretation: Proportion price and volume promotion on less healthy breakfast cereals purchased

Due to the interaction term, the promotion type variable now measures the percentage effect on weekly household consumption of breakfast cereals if there is a percentage increase in the promotion on unhealthy breakfast products bought (compared to the base category "purchases made under no promotion"). The coefficient relates to the less healthy proportion purchased because the health variable is set to zero, so no healthy products purchased (proportion set to zero). It seems that price and volume promotions applied on unhealthy products seem to not have an impact on the mean household consumption and are therefore do not increase the weekly quantity purchased. The results for the quantile regression show that a one percent increase in the proportion of less healthy products bought on price promotion decreases weekly purchases by 0.11 percent for the 25^{th} percentile and 0.15 for 50^{th} percentile. In other words, low/median breakfast cereals consumers purchase less with a price promotion on less healthy products.

For volume promotions the results show that for the 75^{th} and 90^{th} percentile of consumers (high and the highest purchases) a one percent increase in the proportion of unhealthy products bought on volume promotion increases weekly purchases by 0.50 percent and 0.57 percent. The strongest effect is therefore among the most frequent breakfast cereal eaters. It shows that price promotions have the power to decrease consumption when applied to unhealthy products but volume promotions still increase it.

New interpretation: Proportion of healthy breakfast cereals purchased

For the OLS model, the coefficient on the proportion of healthy breakfast cereals purchased (-0.477) measures the additional effect of an incremental increase in household proportional purchases of healthy breakfast cereals (compared to the base category of less healthy breakfast cereals). As above, because this variable is a proportion the interpretation is the following: A one unit change in the proportion is a one percentage point change so, if the proportion of healthy products purchased in Scotland increases by one per cent then weekly purchases of total products would decrease by 0.47 percent. The QR results underline the finding that almost all households (except in the 90th percentile) decrease the weekly quantity purchased when the amount of healthy products increases.

Is there a difference between price and volume promotion to the household's responsiveness across healthiness of products?

Added interaction term: Proportion price/volume promotion* proportion healthy purchases

The added interaction terms try to isolate the effect of promotions on healthy products only to answer the research question, whether there exists a difference between price and volume promotion to the household's responsiveness across the healthiness of products. Again, the OLS coefficients show no significance. In the QR model, the interaction between price promotion and healthy purchases is significant only for the low purchasing households (Q25). A one per cent increase of the proportion of healthy products purchased under price promotion is associated with an increase of (-0.113 + 0.303=) 0.41 percent in the weekly household consumption (weekly quantity purchased) of breakfast cereals, ceteris paribus. Therefore, households purchase more when there is an increase in the proportion of price promotion and an increase in the proportion of healthy breakfast cereals purchased, a result that appears to be only significant for one percentile in the QR model. Next, the interaction between volume promotion and healthy purchases have been found significant only for the lowest purchasing households (Q10). A one per cent increase of the proportion of healthy products purchased under volume promotion is associated with an increase of (0.153 + 0.487=) 0.64 percent in the weekly household consumption (weekly quantity purchased) of breakfast cereals, ceteris paribus. It also shows that an increase in volume promotions given more purchases on healthy products does not have an effect on the mean consumption of households and therefore seem ineffective if aiming at encouraging healthier diets.

Overall, the results show no effect on the proportion of purchases with price promotions on any products and further relatively little effects across the difference between healthy and less healthy products. An effect was found for low and median purchasing households where the interaction model finds a decrease in the quantity purchased for unhealthy price promotional purchases, and an increase in the quantity for healthy products for low purchasing households. The volume promotion allows to reveal a different effect. Those households that buy more under volume promotion on healthy products will increase their consumption the healthier a household is. Among low purchasing households, the

healthier ones buy more under volume promotion than the less healthy. In addition, a volume promotion on unhealthy products increases the purchases for the high purchasing households even more. On the other hand, the result suggests that households that do not buy many breakfast cereals, barely respond to volume promotions on unhealthy products. Overall, households at both ends of the distribution do not buy more products with a promotion – regardless whether a product is healthy or less healthy however there is evidence that volume promotion increases purchases overall. When allowing through interaction terms to vary in the healthiness of products the effect disappears.

To sum up, applying both promotion types on healthy products, it can encourage low purchase consumers to purchase more. However, it underlines that it does not affect the mean and higher purchasing consumer and therefore it is challenging to encourage a healthier diet with a price or volume promotion. More price and volume promotions on healthy products can encourage low purchase consumers to purchase more (in terms of quantity) with for example a price reduction or a multi-buy among the irregular breakfast cereal eaters. High consumption households that include breakfast cereals as a staple part of their diet are not influenced by promotions on healthy products and buy the product regardless of a discount. Low and median breakfast cereals consumers purchase less with a price promotion on unhealthy products, whereas volume promotions on less healthy products encourage consumption of frequent breakfast cereal consumers even more.

5.4.3. Consumption across further dimensions of parameter groups

(iii) Further interesting dimensions among three parameter groups based on Table 5.9.

(1) Socio-economic background of households: What specific household characteristics influence a higher consumption of breakfast cereals?

This section will refer again to the results of the baseline model (Table 5.9.). Households and their socio-economic background influence the amount of breakfast cereals purchased and include individual and overall household characteristics. Overall, the significant coefficients include: age, size of the household, accessibility of households and SIMD. These factors are discussed in turn subsequently.

First, the older the principal shopper is, the less breakfast cereals they purchase. The negative and significant effect of the age of the principal shopper is in line with the food consumption literature suggesting that older consumers usually do not purchase a lot, and purchase even less the older they are.

Second, the coefficients dealing with the size of the household, the number of adults and children living in the household are as expected. The larger the household size (separating number of adults and children), the more household purchase among all level of the distribution. The higher the consumption level, the more impact the number of adults has on the increased quantity purchased, which also has been found for the number of children living in the household. The number of children increases

the amount of products purchased among families significantly across all levels and the effect is stronger in the upper quantiles than in the lower quantiles. The author interprets this as possible evidence of household needs and preferences for more breakfast cereals are growing with the size of the family and therefore underlines the highly important role of the healthiness across breakfast cereals for families especially the more quantity that can be bought with a volume promotion.

Another factor that influences the weekly amount of breakfast cereals purchased is the accessibility of households, which is represented by rural and urban households based on the postcode of the household. Rural households (compared to urban located households) purchase more in a week. The more the household consumes and having breakfast cereals as a stable part in their diet, the more they purchase when their place of residence is considered rural. One possible reason might be that they stock up as rural households do different shopping trips compared to urban shoppers that might not even have a car and use public transport. One could argue that it does not affect weekly purchases since it is only an approximation based on annual purchase data divided by the household's number of weeks in the sample.

However, household characteristics of interest are measures of deprivation such as annual income and SIMD. In a preliminary analysis, annual income was found to be insignificantly affecting the weekly quantity purchased of breakfast cereals. In terms of the level of deprivation of households, the Scottish Index of Multiple Deprivation in the model has been added as dummy variables comparing four SIMD categories (SIMD 1 is the most deprived level) to SIMD 5 (least deprived), which is used as a reference category. The Scottish Index of Multiple Deprivation (SIMD) has not been found significant in any OLS coefficients indicating that it does not affect the quantity purchased. However, for SIMD 1, SIMD 2 and SIMD 3 Q25 and Q50 are significantly negative indicating that more deprived household (compared to the least deprived households) purchase less on a weekly basis. A possible reason for this can be that the least deprived might have more space within the household for storage or might use different modes of transportation such as an own car instead of public transport. Further, the higher status of the consumes might be linked to higher education knowing that eating breakfast is important and skipping breakfast might harm health.

(2) Product information: What product characteristics affect the purchases of breakfast cereals?
In Table 5.9, three other significant product characteristics are the proportion of branded and private label products, the weight of the package and the original full price of the product.

As the proportion of branded products increases, the quantity purchased increases. While the coefficient for branded products is not significant in the OLS, interesting results are found for the QR. The two lowest quantiles show that an increase in the branded proportion increases the weekly purchases, however among the two high purchases quantiles the quantity decreases when the proportion of branded products increases. This might indicate that infrequent consumers prefer brands whereas the

households which purchase breakfast cereals regularly then switch to private label products. The food category where brand is important - especially for households that purchase little quantity it might be valued as a treat, but for high consumers of breakfast cereals can switch to alternatives of private labels.

Regarding the weight of a package, its coefficient implies a negative significant effect on breakfast cereal purchases across OLS and all quantiles of the QR. An increase in the weight of the package decreases the weekly quantity purchased, indicating that large package sizes for a food category like this is too much to eat when the quantity is high and package big. Moreover, breakfast cereal packages are also often bulky and heavy and therefore, the larger the package the more difficult it is to be transported and stored.

With regard to the average weighted full price (per 100g), it negatively impacts breakfast cereal purchases before a promotion has been applied. The more expensive a product is (before the promotion), the less quantity will be purchased. Separating the full price of products by health status gives further insights: An increase in the full price of healthy products is significantly negative across OLS and all quantiles of the QR, but for the full price on less healthy products only negatively significant in the 10^{th} percentile – the lowest purchasing households. This indicates the following: When the product is usually a healthy and expensive product, households across all purchase levels buy less and might be used more like a treat and for special occasions. But on the other hand, for unhealthy products, an increase in the full price only decreases the quantity among the lowest purchasing households. Differentiating by healthiness of the product shows that the unhealthy breakfast cereal price is more price inelastic and therefore more unresponsive to price changes. Consumers purchase unhealthy regardless of the full price changes, however for healthy products decrease the quantity across all purchase levels.

(3) Shop characteristics: Does the shop type play a role on the amount of breakfast cereals purchased in a week?

How much a household purchases in a week is also affected by the place where they shop their breakfast cereals and this analysis includes the variable "discounter" including various chains such as Lidl and Aldi (compared to all other shop types). An increase in the proportion of products purchased in a discounter, shows negative significant results across OLS and all percentiles of QR. A possible reason might be that the consumers that purchase at discounters are already price conscious consumers that might not have extra money to spend or boxes to store and transport. Another reason might be that they do not buy breakfast cereal products in a discounter and prefer buying them in other supermarket types. As discounters consistently offer low price items through the applied Every Day Low Price Strategy, they do not promote extensively through promotions.

5.4.4. Robustness check

In this section, the robustness of the obtained results is assessed through the following exercises. First of all, a critical econometric issue arising in estimating the empirical model is that the right-hand side variables in equation (5.6 and 5.7) and may not be exogenous. Part of the robustness check of the model was the exclusion of households that have been in the sample for 12 weeks or less which decreased the sample size by 10% (2533 households), however it has not changed the estimates significantly, so the study includes the full Kantar Worldpanel sample. Overall, the tests were carried out for robustness purpose and to deal with possible biases towards the analysis of the weekly quantity purchased across households used in testing the relationship between various factors.

Robustness Test: Variance Inflation Factor

To check for multicollinearity, Variance Inflation Factor (VIF) is applied. It is used to measure the degree of multicollinearity in the model and as there are many variables in quantile regression model, they might be highly correlated. Including highly correlated variables can lead to biased and unstable estimation of regression coefficients but also increase the variance and standard error of coefficients, and overall reduce the statistical power of the model. The VIF test was carried out to measure how inflated the variance of a slope is as a result of the non-orthogonality of the independent variables above the expected variance should the variables be uncorrelated. VIF greater than 5 indicates high multicollinearity and 1/VIF not smaller than 0.1.

Table 5.11 shows variance inflation factor test carried out to determine the multicollinearity and possible correlation between the variables used in model 1 and Table 5.12 the VIF test for model 2. The Variance Inflation Factors are smaller than 5 for both models. It reveals that all independent variables can be used as they are not correlated to the dependent variable “weekly quantity purchased” even when including more variables from the “interaction term” (model 2). The highest value of VIF is 3.139 (model 1) and 3.052 (model 2). It shows that it is still below the standard threshold of VIF of 5. This is an indication that there is no need to remove any independent variable as there is no evidence of strong multicollinearity.

Table 5.11 Variance Inflation Factor test for Multicollinearity (model 1).

	VIF	1/VIF
Weight pack	3.139	.319
FP healthy	2.721	.368
FSA health	2.305	.434
SIMD 4	1.925	.52
SIMD 3	1.863	.537
FP less healthy	1.847	.541
SIMD 2	1.827	.547
SIMD 1	1.794	.557
Label branded	1.647	.607
Children	1.358	.737
Discounter	1.339	.747
Age	1.293	.773
Promo Price	1.157	.865
Rural	1.148	.871
Promo Volume	1.106	.904
Adults	1.045	.957
Female	1.037	.965
Mean VIF	1.68	.

Table 5.12 Variance Inflation Factor test for Multicollinearity (model 2).

	VIF	1/VIF
Full price pack	3.052	.328
Weight pack	2.840	.352
SIMD 4	1.922	.520
SIMD 3	1.863	.537
SIMD 2	1.824	.548
SIMD 1	1.794	.558
Label branded	1.582	.632
Children	1.348	.742
Discounter	1.333	.750
Quantity purchased	1.326	.754
Age	1.290	.775
Promo Price	1.149	.870
Rural	1.148	.871
Promo Volume	1.109	.902
Adults	1.046	.956
Female	1.037	.964
Mean VIF	1.604	.

Robustness Test: Matrix of correlations

However, before concluding on whether to include all the variables in the models, a pairwise Pearson‘s correlation matrix was also run. Correlations is often used to explore the relationship among a group of variables. The output gives correlations for all the pairs of variables and each correlation is produced twice in the matrix (Table 5.13). Pearson’s correlation coefficient measures the strength of the association between two variables and are repeated under the number 1 in the diagonal. This value can range from -1 to 1. Table 5.13 describes the pairwise correlation of all variables in the correlation matrix. The resulted correlations allow in this analysis to introduce all variables across the different parameter groups.

Table 5.13 Matrix of correlations.

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) ln_quantity	1.00000																	
(2) Female	0.08662	1.00000																
(3) AGE	-0.11481	-0.11895	1.00000															
(4) NUMADULT	0.16965	0.06079	-0.03215	1.00000														
(5) CHILD	0.27991	0.15403	-0.43234	0.06966	1.00000													
(6) SIMD_1	-0.06057	-0.00688	-0.09945	-0.03655	0.02217	1.00000												
(7) SIMD_2	-0.03185	-0.00371	0.01086	-0.02658	-0.03657	-0.25886	1.00000											
(8) SIMD_3	-0.01629	-0.00775	0.00218	0.00584	-0.02949	-0.25128	-0.27138	1.00000										
(9) SIMD_4	0.05226	0.00431	0.01326	0.03261	0.02960	-0.25325	-0.27350	-0.26549	1.00000									
(10) rural	0.06384	0.00657	0.03761	0.04226	0.04598	-0.17862	-0.11015	0.15366	0.25676	1.00000								
(11) WDpromo_Price	0.01043	0.02274	-0.06926	0.00726	0.07575	-0.00943	0.00618	-0.01224	0.06083	0.02094	1.00000							
(12) WDpromo_Volume	0.11407	0.00163	-0.06570	0.01345	0.05044	-0.00942	0.03660	-0.02785	-0.02560	-0.00931	-0.13679	1.00000						
(13) WFSA_health	-0.58881	-0.08651	0.04773	-0.12316	-0.19628	0.05420	0.01231	0.00655	-0.03058	-0.03651	-0.09996	-0.07007	1.00000					
(14) Wlabel_branded	-0.08610	0.01490	0.04224	0.05569	-0.04386	0.01091	0.00746	-0.01373	0.01363	-0.01504	0.25931	0.16449	-0.02725	1.00000				
(15) ln_Wweight_pack	-0.67752	-0.10865	0.11099	-0.16015	-0.27354	0.07761	0.00743	0.00217	-0.03947	-0.03022	-0.04164	-0.13206	0.71756	-0.01225	1.00000			
(16) ln_WFP_healthy	-0.69916	-0.07095	0.03323	-0.13990	-0.22915	0.08217	0.02757	-0.00498	-0.03150	-0.04832	0.05472	-0.04826	0.61303	0.30379	0.69809	1.00000		
(17) ln_WFP_lesshe~y	-0.50777	-0.07290	0.13825	-0.15372	-0.26429	0.03171	0.01832	0.00732	-0.04773	-0.03176	-0.08831	-0.05018	0.56288	0.03463	0.63569	0.55200	1.00000	
(18) Wdiscounter2	0.02165	-0.02098	0.01766	0.00722	0.01662	0.03921	0.02419	-0.01841	-0.00465	-0.00824	-0.17559	-0.13077	0.01300	-0.48106	-0.02290	-0.20031	-0.04422	1.00000

5.5. Conclusion

Promotional purchases influence the consumption of breakfast cereals by households

This chapter aims to shed light to the factors that influence the quantity of breakfast cereals purchased employed with OLS and QR to identify the role of retail promotions on the consumption, being aware that retail purchase data that is not equal to the exact level of consumption excluding information e.g., on the waste. Results of the quantile regression show that the associations vary significantly across the purchase distribution. Overall, not only household socio-economic characteristics but also product and shop characteristics are important when households make purchase decisions.

The first model found, that both price and volume promotions increase weekly breakfast cereal purchases. An increase in the proportion of both types of promotional purchases increases the quantity households purchased. The strongest effect has been found across promotional purchases under volume promotion with significant estimates across the full distribution except for the highest purchasing households. For price promotions, the association was weaker and only significant for the lowest purchases. However, the nature of the promotions needs to be acknowledged when interpreting the results. It seems that consumers use price promotions not to increase the quantity of weekly purchases, rather to test unfamiliar products and experiment with them as they do not 'waste' too much money but also do not commit to purchasing a multi-buy. Also, the cross-category promotion effect or reliance on frequent promotions coming up has to be considered, whereas the nature of volume promotions always increases the quantity purchased as it is for instance linked to a 'buy-one-get-one-free'. Volume promotions seem to be preferred among high purchasing households as their consumption level is greater and breakfast cereals are an essential part of their diet und therefore use a multi-buy for habitual purchases.

Overall, no large effect that households that buy more under promotions disaggregated by healthy or less healthy products were found – most households purchase the same amount than households that buy little or nothing under promotion. The second model took into consideration the responsiveness of households towards healthy and less healthy promotional purchases, the results highlight the following: Price and volume promotions on healthy products can encourage low purchase consumers to purchase more (in terms of quantity) with for example a price reduction or a multi-buy and can encourage more consumption among the irregular breakfast cereal eaters. High consumption households that include breakfast cereals as a staple in their diet are not influenced by promotions on healthy products. However, the quantile regression results give further insights than the insignificant OLS coefficients. Low and median breakfast cereals consumers purchase less with a price promotion on less healthy products, whereas volume promotions on less healthy products encourage consumption of frequent breakfast cereal consumers even more. Therefore, healthiness impacts the responsiveness to promotions and is a right approach of policy makers include in their plans to ban promotions on less

healthy products. In other words, healthy purchases linked to an increase in price promotion can positively impact and increase consumption (for the good), whereas less healthy purchases linked to volume promotions can increase consumption (for the bad). Volume promotions often lead to more purchases than the consumer intended to buy or may need (just to make use of the promotional offer), incentivising over purchasing and over consumption.

Positive associations between breakfast cereal consumption and household characteristics were largest for households with larger families (with a higher number of adults and children in the household). Further, households in more rural areas seem to purchase more. Moreover, the level of deprivation matters. Compared to the least deprived category, households in all other levels purchase less in terms of quantity, thus deprived households purchase more breakfast cereal that others. When looking at product characteristics it is important to consider the following factors that decrease the quantity that household purchase in a week: an increase the proportion of healthier breakfast cereal products and more expensive products. The size of the packages matters in the category of breakfast cereals as packages are relatively large and bulky – the bigger the package the less consumers buy across all households. Moreover, the brand seems to play in important rule in the purchases. Branded breakfast cereal products compared to private label products seem to be purchased more among the low purchase households, but less among the high purchase households. Besides, a discounter is not a shop category where consumers buy more products across the full distribution of purchases.

As a part of the model discussion, it has to be mentioned that the OLS model overstates (understates) the effect of household characteristics, but also product and shop characteristics on the breakfast cereal purchases at the lower (higher) half of the distribution. This suggests that conclusions from standard models (e.g., OLS) that assume uniform response across different quantiles of the breakfast cereal purchase distribution may be misleading. This is most profound for the number of adults and children in the household, rural households, the volume promotion as well as the weight of the products. Also, the OLS results did not find any association for the SIMD variables, the price promotion variable and the full price on less healthy products and the branded products but the quantile regression estimates did. Figure 5.8. offers a graphical summary of key findings from this empirical chapter.

Figure 5.8 Graphical summary of key findings from Chapter 5.

Chapter 5 **Demand-side orientation**	**Factors that influence breakfast cereal consumption…**	
	Increase in purchases	**Decrease in purchases**
Price promotion		
Volume promotion		
Socio-economic characteristics		
Older principal shopper		
Larger household size		
Rural households		
More deprived households		
Female principal shoppers		
Product characteristics		
More expensive products		
Healthier products		
Larger package size		
Branded products	* low purchasing households	* high purchasing households
Deep promotional discount		
Shop characteristics		
Discounter		

Important for the discussion on the results is a recap on the role of breakfast cereals and the healthiness linked to price. Based on the literature, healthy food is more expensive and it is a common belief that the most deprived can mainly afford less healthy food. In many categories it has been confirmed that healthier products are more expensive and that is why it is expected that the demand for purchases under promotion are higher for healthy and expensive products. However, one important characteristic of the breakfast cereal category is that the healthy products are also the cheaper ones. The cheapest breakfast cereals are mostly unprocessed for example shredded wheat and these are also the healthiest because processing grains leads to a reduction of the nutritional value. On average, the less processed breakfast cereals are healthier and cheaper, also because they need fewer ingredients and are therefore easy to duplicate by private label brands. For instance, porridge oats are healthy minimal processed products that are cheaper than the ready-to-eat-breakfast cereals. An example is given in section 2.5.2. highlighting the price per packs and per 100g across a range of healthiness. Overall,

drawing from the findings to quest the answer to the research question: Retail promotions seem to encourage less healthy eating. Evidence shows that retail promotions increase purchases, especially among less healthy products. However, differentiating strategies and encouraging healthier diets is possible through specific targeting of household, variations in product characteristics and a combination of targeted strategies including promotion types and healthiness of products. This study supports UK and Scottish government plans to ban volume promotions on less healthy foods based on the results from the study as promotions increase purchases and therefore the danger of overconsumption of less healthy sugary ready-to-eat breakfast cereals. The issue of stockpiling through volume promotions is the increased consumption or even an immediate overconsumption instead of purchasing products at a cheaper price and consuming it later when needed (Chandon and Wansink 2002).

Relative to prior studies this study contributes through the following aspects:
(i) An emphasis on the applied strategies of the retailers to use certain promotion types on various products based on barcode specific data of a Scottish consumer panel;
(ii) A methodological approach that models the retailer's promotional strategies as a dependent variable differentiating between supermarket promotion types and relate them to a set of factors
(iii) Implementation of the UK FSA nutrient profiling score to investigate impact of the health status of a product in the breakfast cereal category.

However, a limitation of this study is that it represents a Scottish sample and one part of the breakfast diet based on take home retail purchases excluding out of home consumption. For a food category like breakfast cereals partly belonging to ultra-processed foods, the results are still important. Taking into consideration the power of retail promotions as it can encourage healthier purchases and therefore plays a crucial role in the food environment and shaping consumer purchases for the better.

Chapter 6

6. The power of retail promotions and policies to encourage healthier purchases

6.1. Introduction

This thesis chapter addresses the challenges of governments trying to fight obesity, especially childhood obesity and encourage healthier purchases and therefore healthier eating. On the one hand, what do consumers want to eat and what do they purchase? On the other hand, are the retailers offering less healthy products with promotions to encourage sales? Do the three parties want the same? While governments try to promote healthy eating and support consumers with tools such as front-of-pack-labelling, consumers face other challenges in their regular shopping routine – different retail promotion types across a range of product encourages consumers to make use of promotional offers for their own good. But is this really the best for them? This empirical chapter will investigate across the average healthiness of purchases by the households – from healthiest to the least healthy consumers including various promotion types and socio-economic characteristics of households but also looks at certain product characteristics such as the brand of a product or the weight of the package. The study examines the influence of socio-economic household characteristics, product characteristics and shop characteristics on the healthiness of household purchases in 2015 across different quartiles on the basis of the healthiness of their purchases.

Figure 6.1 The role of promotions across the aims of retailers, consumers and policy.

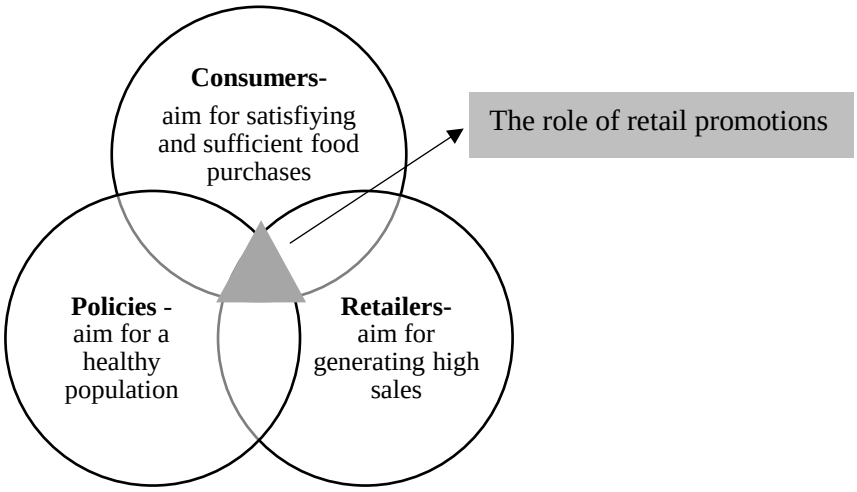
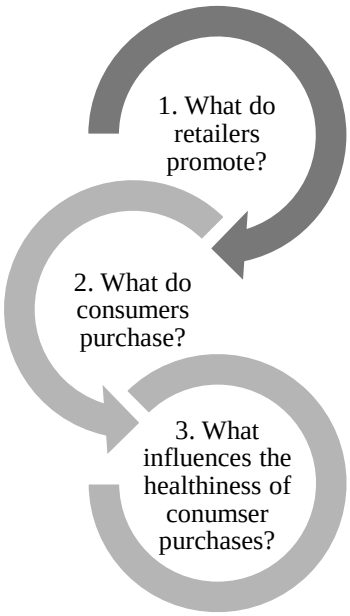


Figure 6.1. visualises three different parties and three different aims when dealing with retail promotions – can they be combined with what consumers purchase and success for retailers but also encourage healthier diets to put less pressure on the health system of governments? What has the United Kingdom already done on the policy level and what are the future plans? This thesis aims to investigate policies to improve the retail environment towards promoting healthier purchases. Using 2015 Kantar Worldpanel data Scanner data in Scotland, this chapter estimates the factors (such as household, product and shop characteristics) that decrease the healthiness of household purchases to further determine the characteristics of households and products and shops that make purchases less healthy. Moreover, the findings seek to understand whether restricting volume promotions might help consumers to purchase less of unhealthy products, and whether the discussion on policies by governments to ban multi-buys on HFSS products is supported by the findings. Overall, what type of policies regarding retail promotions might be successful in encouraging healthier diets besides restricting volume promotions?

There has been a growing concern among government, organisations and academics about retail promotions and their impact on influencing food choices towards purchasing less healthy products. Evidence shows that promotions are effective at impacting consumer purchases, often skewed to less healthy foods (Riesenberg et al. 2019a; Bennett et al. 2020; Coker et al. 2019; Smithson et al. 2015). Price promotions are a fixed part of the food environment and part of almost over half of the purchases, and volume promotions on the other hand led to customers buying almost 20% more than intended (UK Government 2020). Also, this thesis has proven that promotions are applied more towards less healthy products and that they increase purchases – for the case of breakfast cereal purchases in Scotland. This chapter now aims to answer the following questions: Do promotions also lead to less healthy purchases? If so, do price and volume promotions have the same influence on the healthiness? Do the findings support the UK and Scottish Government plans to ban volume promotions?

To recap, this analysis develops from the storyline of the thesis as visualised by Figure 6.2. starting from the first empirical chapter (Chapter 4) that examines what products retailers promote, moving on to the second empirical chapter (Chapter 5) that examines what consumers purchase and consume, to this third empirical chapter (Chapter 6) investigating what factors influence the healthiness of purchases. All chapters focus on the role of two retail promotions but investigate it from different points of view.

Figure 6.2 Construction of research story.



This chapter aims to shed light on the policy side of retail promotions. Further, it provides an overview of policies how the United Kingdom is working towards achieving healthier diets and therefore tackling the obesity crisis. The rest of the chapter is organised as follows. Section 6.2. presents evidence from the food economics literature on the influence of retail promotions on the healthiness of purchases. Section 6.3. describes UK policies programmes that have been implemented including restricting volume promotions to encourage healthier food purchases, and further introduces an OECD report published by the author providing a framework for policies encouraging healthier food choices. Section 6.4. gives an overview of the method and data and Section 6.5. presents the empirical results on the healthiness of households across promotional purchases and concludes that policies should restrict promotional offers, especially on less healthy products. Section 6.6. highlights a discussion of the results and Section 6.7. wraps up with a summary of policy remarks confirming the rationale of the thesis.

6.2. The influence of retail promotions on the healthiness of purchases

Evidence shows socio-economic inequalities in the prevalence of non-communicable diseases including diabetes type 2, cardiovascular disease and cancer, the key determinants of which are behavioural risk factors, including unhealthy diets (Afshin et al. 2019). According to the literature and reports from the WHO and the Scottish government, obesity and overweight is more prevalent in low socio-economic groups. Further, the consumption of unhealthy diets is also strongly patterned by socio-economic status (SES) (Darmon and Drewnowski 2008; Appelhans et al. 2012; Pechey et al. 2013; Pechey and Monsivais 2015; Pechey et al. 2015).

There have been various studies on the healthiness of households, the influence of promotions on purchases and the importance of socio-economic factors influencing food choices, most of which have been conducted using quantitative methods. Studies have investigated household food purchases focusing on various socio-economic characteristics and they have found that socio-economically disadvantaged consumers purchased more unhealthy foods compared to higher socio-economic groups. (Turrell et al. 2002; Hulshof et al. 2003; Appelhans et al. 2012; Pechey et al. 2013; Ball et al. 2015; Nakamura et al. 2015; Revoredo-Giha et al. 2018). To recap from the previous chapters, research has shown that supermarket promotions are disproportionately applied on food products that are energy-dense, nutrient-poor and often considered less healthy and are mainly applied on product categories such as confectionary and high sugar products. Looking at breakfast cereals, the highly sugary ones targeting children are promoted most often. A review by Bennett et al in (2020) offers a great summary of the recent literature on the prevalence and influence of price promotions for healthy and less healthy foods and beverages. They find evidence across 16 studies that price promotions are more frequently applied to less healthy compared with more healthy foods and beverages in high-income countries. The literature states that price promotion has been linked to an increase in purchases suggesting that the impact is greater for less healthy food options. Riesenberg et al. (2019b) support in their study that price promotions have been used more frequently on less healthy food categories (29%) compared to healthy ones (15%) and that the magnitude of discount was greater for less healthy food categories; on average 26% compared to 15% for healthy food categories.

Retail promotions and healthiness: Studies based on UK data

An overview of recent UK studies that used the same dataset as this thesis, namely Kantar Worldpanel, will be presented in the following section. Coker et al. (2019) show in their report using UK Kantar Worldpanel data a greater proportion of price promoted purchases for unhealthy food and beverage compared to healthy. Moreover, they examine the role of promotional shoppers among the purchases and reveal that high promotional shoppers purchase a higher quantity of unhealthy foods and beverages, less fruits and vegetables and their purchases were higher in sugar and lower in fibre compared to low promotion shopper. Approximately 11 additional unhealthy items are purchased per month across high

promotional shoppers. Linking this purchase behaviour to diet and health, high promotional shoppers (the quarter of shoppers who buy the largest proportion of their basket on promotion) are 28% more likely to be obese than low promotional shoppers. The study finds that the relationship between overweight/ obesity and purchases with a promotion across all income groups, and is independent of age, life stage, and region.

Another study Revoredo-Giha et al. (2018) agrees with these findings, analysing UK Kantar Worldpanel household panel purchase data, and concludes that a price promotion increases the spending of household expenditure up to 10% among less healthy food categories compared to more healthy categories. For instance, 10% for confectionary, 6% for soft drinks, about 5% for fruit and vegetables, and 3% for grains. Nakamura et al. (2015) find in their study that sales uplift from price promotions is larger for less healthy food categories compared to healthier ones after controlling for reference price, price discount rate, and brand specific effects with this effect being most marked among individuals from the lowest socio-economic group. Moreover, they reveal a trend toward larger discounts for less healthy foods than for healthier foods. However, the frequency of price promoted purchases is not statistically different between healthy and less healthy food and therefore had a similar prevalence of price promotions amongst purchased products analysing Kantar Worldpanel data household purchase data of Great Britain from 2010. They also utilise purchase panel data as a proxy for availability of price promotions in a supermarket, as it was done in the first empirical chapter of this chapter.

Smithson et al. (2015) use ten years (2005-2015) of UK Kantar Worldpanel data modelling the sales uplift directly attributed to priced promotions and discover a 22% net growth in sales volume because of price promotions, 59% of sales because of brand switching, and 18% because of consumers bringing forward future purchases for example through stockpiling. Therefore, they underline that price promotions encourage consumers to buy more than they would otherwise. Moreover, they state that 41% of consumer expenditure was for price-promoted foods or beverages and for foods with the highest sugar by volume, 51% of expenditure was purchased on a price promotion, compared with 45% for less sugary foods. McDonald and Milne publish studies for the Scottish Food Standards Agency of retail promotions und support these findings for Scottish consumers. In the initial study in 2016, they investigate 5 years of household panel purchase Kantar Worldpanel data in the UK (2010-2015) and find that 50% of unhealthy “discretionary” foods, and 30% of healthy “core” foods were purchased while price promoted. In a follow-up study in 2018, they report that across all price-promoted purchases the highest has been found for unhealthy food groups such as crisps and savoury snacks (53%), puddings and desserts (45%), confectionary (48%), sugar-sweetened soft drinks (52%), and biscuits (44%) (McDonald and Milne 2018). A Scottish monitoring report finds that purchases made under promotion continue to be skewed towards less healthy categories from 2016 to 2018, in other words higher purchases have been made of less healthy foods on promotion, compared with healthier foods (Campbell et al. 2020).

It is clear from the literature review that promotions are generally more prevalent on less healthy food categories or products for instance confectionary and high sugar products. Regarding breakfast cereals, the highly sugary ready-to-eat breakfast cereals are most often promoted targeting children. Linking this to the evidence that the influence of retail promotions is strong in general and realising that the literature hardly distinguishes between promotion types or summarised on/off promotion, this study will differentiate between promotion types. This again demonstrates a novelty of this study and emphasises the value it contributes to the literature.

Promotional purchasers in Scotland

A study by FSA (Campbell et al. 2020) looks at retail promotions across Scotland using Kantar Worldpanel data from 2014-2018. It includes a description of the dataset about promotional purchases and also interprets the data as proportion of products bought under promotion. They find that the average household purchases 29.2% of their food and drink items (and 28.5% of volume) on promotion (not differentiating by promotion type). It is slightly lower than findings from Food Standards Scotland reporting for 2016 that 33% of take-home food and drink volume was bought on promotion in Scotland and Public Health England stated around 40% of volume in Great Britain in 2015 (McDonald and Milne 2018) . They further categorise promotional purchasing groups as low promotional purchasers that buy 0 to 21% on promotion, medium promotional purchasers from 21% to 38% and high promotional purchasers that buy 38% to 82% under promotion. The result shows that promotional purchasing was associated with an increase in buying products high in fat, salt and sugar (HFSS) with high promotional purchasers buying 17.6% more HFSS items (and 25.2% more HFSS volume) compared to low promotional purchasers. High promotional shoppers also buy a quarter more of HFSS in terms of volume and for instance a two-adult, two-school-child household around 11 extra HFSS items a month compared to low promotional shoppers indicating that high promotional purchasing households do purchase more unhealthy foods. The nutritional content of their shopping basket shows that they buy more carbohydrates and sugar, less protein and fibre, but also more cakes, confectionery and crisps than low promotion purchasing consumers. Taking into account that 87% of UK adults exceed the recommended sugar intake and on the other hand 91% are under-consuming fibre, this promotional variable plays an important role in the debate on healthier diets (Campbell et al. 2020). To go one step further, these high promotional shoppers are more likely to be obese (28%) than low promotional shoppers – this association was seen in all income groups and independent of age, life stage or region.

To conclude, it is vital to link Scottish purchases to retail promotions, but also to healthiness of purchases and one step further to overweight and obesity among the consumers to shows the real impact that promotions have. Not only do promotions increase the volume purchased by 29%, but also increase the purchases of less healthy food by 25% and next increase the obesity rate among consumers by 28%. The paper includes policy discussions and strongly calls for a restriction of the retail promotions of less

healthy foods and drinks implemented across the UK. Further, they express to be in favour of mandatory measures to restrict promotions and marketing of HFSS products especially multi-buys and for the UK Government to commit to review how these policy changes might be able to impact in-store promotional activity.

6.3. The role of policies on encouraging healthier purchases

High obesity rates, an increasing consumption of UPF and the issue of food insecurity. The UK government plans to implement different instruments and regulations to help consumers to make healthier food choices and at the same time includes programmes that restrict and regulate further. Countries across the globe such as the UK, New Zealand, or Australia have implemented policies to restrict advertising, which underlines the importance of such policies and strategies, acknowledging that no country has managed to reverse the obesity crisis so far. The recent action plans of governments across the world show the need for research in this field and this study will focus on the United Kingdom, analysing Scottish scanner data. However, until now no jurisdiction globally has been implemented through regulatory measures to reduce the influence of promotions used by the supermarkets on less healthy foods and beverages. Considering the importance of the food category breakfast cereals a suitable summary by Devi et al. (2014, p.260) is related to policy recommendations based on their study and include the need for "food composition targets set or endorsed by government, strengthening and forcing current regulations on health and nutrition claims, considering the application of nutrient profiling for nutrition claims in addition to health claims, introducing an interpretative front-of-pack labelling system and restricting the use of promotional characters on 'less healthy' breakfast cereals". Further public policies and actions that promote consumption of unprocessed or minimally processed foods and make ultra-processed foods less available and affordable are needed (Monteiro et al. 2018). The UPFs category is highly relevant because consumers in the United Kingdom consumes more than 50% of the products as ultra-processed, therefore the breakfast cereal category is a suitable category to address this issue.

Overall, the planned initiatives by governments, retailers and manufacturers to improve the consumption and restrict the food marketing further for less healthy products and increase the healthier and more nutritiously rich breakfast cereal products are an effective way across the United Kingdom. However, the consumers still have to accept the new products in order to change their diet for the better, which depends on not only the socio-economic background such as the education and income available but also the price of the products as well as the communication of the health benefits (Costa-Font and Revoredo-Giha 2019). The implemented and planned policy measures by the UK government underline the relevance of the thesis to investigate the promotion tools across different types also directly linked to the healthiness of the food products. Overall, the UK government implements different policy

measures to support healthier eating (Table 6.1) highlighting the urgency to improve the health of the population.

Table 6.1 Overview of UK government policies supporting healthier eating.

What policy plans has the UK government already implemented?
04/2016 Soft Drink Industry Levy 08/2016 Obesity Plan 1 03/2018 PHE calorie reduction programme 06/2018 Obesity Plan 2 06/2019 Obesity Plan 3 12/2020 Paper on ban of multi-buys 07/2021 Promotions on food and drinks high in fat, sugar and salt (HFSS) in retailers will be restricted from October 2022

The National Food Strategy from 2020 will build on the work underway in the Agriculture Bill, the Environment Bill, the Fisheries Bill, the Industrial Strategy and the Childhood Obesity Plan. It is intended to be an overarching strategy for the UK government and is supposed to ensure that the UK food system can ensure what is most important: delivers safe, healthy, affordable food; regardless of where people live or how much they earn (National Food Strategy 2020).

The recently proposed legislation in the UK and Scotland to reduce the influence of retail promotions on unhealthy food and beverage purchases is an attempt to improve the diet and therefore the obesity problem. The policy measures in national policy agendas include (i) a restriction on the use multi-buy price promotions, (ii) restricting the advertising of price promotions in-store, (iii) restricting the placement of unhealthy foods and beverages at i.e. checkout, end-of-aisle, (iv) restricting the sale of unlimited refills of unhealthy foods and beverages (Backholer et al. 2019). This study will inform the debate further especially in Scotland on the role of supermarket promotions and their influence on purchase and consumption behaviour. The results of this empirical chapter will highlight whether banning volume promotions of less healthy foods is a promising policy tool and investigate other policy options in the retail environment that might encourage healthier food choices.

6.3.1. Policies linked to restricting retail promotions

The literature review highlights that there is limited consent describing the influence of price promotions on food products; of the recent evidence that is available, across a range of countries (mainly including the USA, UK, Australia and New Zealand), price promotions applied to unhealthy products are ubiquitous in the retail environment. However, it gives an indication that retail promotions are more commonly applied to less healthy foods and beverages (compared to healthier ones). Several studies in this field have assessed the policy implications based on their research findings. Moreover, other key

international organisations have also expressed support for regulatory policies such as the ones introduced by the UK and Scottish government (Smithson et al. 2015; OHA 2017) Riesenberg et al. (2019a) acknowledge in their study that the UK government is one of the first governments that proposed polices to restrict promotions on less healthy foods eventually providing further information and data on the evaluation of consumer and industry responses to such regulations.

Bennett et al. (2020) review the recent literature of the prevalence of promotions and mention that they did not identify evidence whether restricting policies would be effective in changing the purchases made, as well as the overall diet and weight. Moreover, they refer to an independent analysis of the public consultation commissioned by the Scottish government on recommendations to restrict unhealthy food and beverage price promotions and refer to a negative industry response to this proposed policy recommending instead public education programs about healthy eating (Griesbach and Waterton 2018). It seems unlikely that policies will be recommended, adopted and prioritised facing strong opposition unless they are underpinned by more extensive evidence base. "There is also concern that a failure to restrict price promotions on unhealthy foods and beverages could partially undermine the effectiveness of other high-profile pricing strategies to improve population diet, including sugar-sweetened beverage taxes" (Bennett et al. 2020, p.19). A study from New Zealand mentions that public health policies that target private label products through for example pricing and promotional strategies, nutrition labelling and reformulation, may have a limited capacity to improve population nutrition. However, they state that policies that reduce the influence of less healthy food and beverage price promotions need to be considered in nutrition and obesity-prevention strategies. Further, they urge that the in-store dominance of ultra-processed foods relating to availability and other marketing strategies should be included further in the food and nutrition polices (Zorbas et al. 2020).

A study by Backholer et al. (2019) investigates the potential of policy options to reduce the prevalence and influence of price promotions on unhealthy foods and beverages (defined as products high in one or more of salt, sugar and saturated fat). They conclude the potential of promotions to be linked to further food policies and therefore improve population diets in the long term. Further they present the importance of prices when trying to encourage healthier food purchases through policies such as (i) decreasing the price of healthier foods through subsidies or price discounts or (ii) increasing the price of less healthy foods through introducing food taxes. Lowering the price of healthy products seems not to be feasible at population level due to the great implementation barriers. Instead, one option might be targeting specific SES groups. Lowering the price is not part of the solution because studies reveal that the saving that results from the discounted price leads consumers to purchase less healthy products. Further, the study calls for economic modelling of the costs and benefits of different policy options and evaluation of real-world policy implementation by jurisdictions that are willing to test new approaches such as taxes in sugar-sweetened beverages (Backholer et al. 2019).

However, as mentioned in the introduction, the aims of the included parties differ on the role of retail promotions and the response of consumers, manufacturers and retailers to such restrictions remains unknown until such policies are implemented in practice. Evidence from retailer responses to the UK and Scottish consultations has already revealed that retailers would prefer a mandatory, instead of a voluntary approach in order to create a 'level playing field'. Voluntary commitments have been tried such as stopping volume promotions but when these commitments are not implemented consistently or at large scale they might not be successful (UK Government 2020).

UK government research on restricting promotions

Potential policy options are summarised in Backholer et al. (2019) and the ones under consideration in Scotland and across the UK include: (i) Legislation to restrict price promotions on unhealthy food and beverages, (ii) Legislation to restrict the advertising of price promotions on unhealthy food and beverages (in media, circulars, brochures, catalogues, in-store) and (iii) Legislation to restrict placement of price promoted unhealthy food and beverages in prominent locations in retail outlets (e.g. at end of aisle displays and at checkouts).

A recent UK government report (2020) "Restricting promotions of products high in fat, sugar and salt by location and by price" from the Department of Health and Social Care has been assessed in a consultation outcome from December 2020 and the following has been concluded: "Government decided to legislate to restrict promotions of HFSS products by price (volume promotions) and location (checkouts, end of aisles and store entrances) in medium and large retailers that sell food and drink in England". This means that price and location restrictions will apply to a specified list of product categories that are significant contributors to children's sugar and calorie intakes and are heavily promoted – it includes the breakfast cereal category. The aim of this policy is to restrict the promotion of foods high in fat, sugar and salt (HFSS) in favour of healthier options to help improve people's diets. HFSS products are food and soft drink products that are high in fat, salt or sugar as identified using a nutrient profiling and their definition of HFSS products is implemented by the 2004/2005 Nutrient Profiling Model, which is also used in this study to categorise healthy and less healthy breakfast cereals.

In 2019, the UK government (Department of Health & Social Care) as well as the Scottish government proposed plans to reduce overconsumption of less healthy foods by restricting promotions of products that are high in fat, sugar or salt and to restrict the use of promotions on unhealthy foods in the supermarkets. One of the mentioned policies is to restrict volume promotion types, which manifest in for example multi-buys, encouraging overconsumption of less healthy food products. Through this intervention the government plans on impacting the balance of healthier products sold under promotions in the supermarket. Evidence confirms that retail promotions are effective at influencing purchases and tend to be skewed towards less healthy products and especially the role of volume promotions is examined as they steer consumers to buy almost 20% more than intended (UK Government 2020).

From a health perspective, a Public Health Report declares an important area for action to reduce and rebalance the number and type of price promotions in all retail outlets including supermarkets and convenience stores and the out of home sector (Tedstone et al. 2015). Another possible implementation is to link advertising restrictions for TV and online advertising for products high in fat, sugar and salt to a nutrient profiling score since 2017, especially considering food marketing targeting children. The British government published two childhood obesity plans (in 2016 and 2018) and a ban on promotions is discussed as part of the obesity childhood plan to tackle obesity. A recent consultation paper (UK Government 2020) about "Restricting volume promotions of HFSS products" gives several policy options including to (i) require retailers to ensure that all their volume price promotions on food and drink are on healthier products and (ii) alternatively requiring retailers to ensure that at least 80% of their sales from volume price promotions on all food and drink per year are on healthier products. Promotions on food and drinks high in fat, sugar and salt (HFSS) in retailers will be restricted from October 2022, the UK government confirmed in July 2021.

Coker et al. (2019, p.39) recommend in their report "Paying the price: New evidence on the link between price promotions, purchasing of less healthy food and drink, and overweight and obesity in Great Britain" that the UK, Scottish, and Welsh Governments should:

> "1. Introduce restrictions on price promotions for less healthy food and drink items, focusing first on multi-buy offers. These policies should be as aligned as possible across nations.
>
> 2. Commit to reviewing the evidence base on other kinds of price promotions, including temporary price reductions, and take further action to restrict those if necessary.
>
> 3. Introduce restrictions on location-based promotions for less healthy foods to support restrictions on price promotions.
>
> 4. Fully implement other measures in their respective obesity strategies, to create a healthier food environment and support families to make healthier choices."

Further they mention the need for future research that should examine consumer behaviour across different promotion types to be able to extend the future government regulations. An ESRC-funded study by Dobson (2014) has analysed the types of food products that are sold under promotion in major British supermarkets and motivates their research with the role of promotions and includes the argument that price promotions have been criticised for encouraging excessive consumption but also less healthy food habits, which potentially contribute to the increase in obesity. They investigate the reasons for retailers offering mainly less healthy foods and conclude that they prefer selling higher value-added products, but also to encourage purchases in bulk of processed foods that are high in fat and sugar because they are easier to stock. Moreover, other reasons could be to categorise customer types for instance into price-conscious 'tempted' consumers and on the other hand health-conscious 'disciplined' consumers. Also, it could simply be used to encourage more consumption and therefore more frequent

store visits. They examine a promotional bias towards unhealthy foods in particular for sugary, fatty and salty food products. Overall, special deals are 20 percent more likely to have red traffic light levels of sugar compared to non-offers. In particular, 'buy one get one free' (BOGOF) deals are heavily skewed towards less healthy products. Further, they include policy relevance and implications in their study, suggesting a combination of formal requirements and government pressure and call for:

- "Requiring supermarkets not to **use misleading price promotions** which exaggerate the level of discount or use artificial reference prices, so as not to encourage consumers to make excessive food purchases that they subsequently waste or overeat.
- Strongly encouraged to **offer small portions and pack sizes** at a similar unit price to larger sizes, to discourage consumers from supersizing and overeating.
- Supermarkets strongly encouraged to curtail the use **of multi-buy discounts** on perishable fresh products and processed foods high in fat, sugar and/or salt which encourage over-buying, resulting in increased food waste and overeating."

Linking the role of promotions to Scottish reports, Martin et al. (2017) revealed in their rapid review[4] from the NHS in Scotland that the products most likely to be discounted through multi-buy promotions were less healthy foods and that this type of discount drives the greatest increase in sales compared with temporary price reductions. This study based on Kantar Worldpanel data shows that up to 83% of purchases made on price promotion are impulse purchases, leaving only 17% planned purchases. Further, recent Scottish data from 2014-2018 shows that (Campbell et al. 2020).

- shoppers who buy more on promotion buy greater amounts of less healthy food and drink,
- promotional purchasing is associated with changes in overall nutrition,
- promotional purchasing is skewed towards less healthy food categories,
- shoppers who buy more on promotion tend to buy less fruit and vegetables.

A more critical view on the ban of volume promotions is underlined by Revoredo-Giha (2020). He mentions that there will be a modest impact on the purchases as well as consumption, however further actions are required such as reformulation and the consumers' willingness to change their diets. The report mentions that the Scottish government announced to put the legislation (Restricting Foods Promotions Bill) on hold due to the COVID-19 pandemic effects.

[4] While rapid reviews can be useful to address a specific research question in a relatively short period of time, they are neither systematic nor peer reviewed.

6.3.2. Policies linked to improving healthiness of food purchases

Other policy options to encourage healthier eating that go beyond the role of retail promotions will be described in the following section giving mainly UK examples based on recent government plans (Restricting volume promotions of HFSS products: impact assessment 2020):

(i) Restrictions on products high in fat, sugar or salt (HFSS) advertising

(ii) Positioning and placement of unhealthy foods and beverages

(iii) Reformulation

(iv) Calorie / Sugar / Salt Reduction Programme

(v) Front-of-pack labelling

(vi) Soft Drinks Industry Levy

(i) Restrictions on products high in fat, sugar or salt (HFSS) advertising

The thesis deals with the role of retail promotion types and the restriction of them. Similar to the promotion ban, a restriction on general advertising has been considered by the UK government for instance in the impact assessment (2020) and the Childhood obesity plans. There exist unavoidable interactions between retail promotions and advertising which are both implemented by food and drink manufacturers and retailers. The restrictions include further constraints on marketing strategies such as TV and online advertising for HFSS products aiming to be implemented by the end of 2022. Based on a government consultation such as the Tackling Obesity Strategy from 2020, Government announced that a 9pm watershed on TV for less healthy products. The Government's impact assessment of the introduction of the 9pm advertising watershed concluded that the policy would save the economy £2.7 billion (including NHS and social care savings and increased economic output) because of the reduction in illnesses such as type 2 diabetes or coronary heart disease (National Food Strategy 2020). Further, the restrictions include a wider set of policies such as a ban of free refills of sugary drinks in the out of home sector but also further policies such as ending the sales of energy drinks to children, or to mandating consistent calorie labelling in takeaways. The aim is to halve childhood obesity by 2030 and to support the parents making the best decisions for their family and making the healthier choice the easiest choice (Government's Childhood Obesity: a plan for action 2018).

(ii) Positioning and placement of unhealthy foods and beverages

Further plans are to restrict certain positioning of less healthy products in-store. Potvin Kent et al. (2017) conclude in their study that the use of promotional location such as the mid aisle displays and positioning of healthier breakfast cereals is recommended to make them more visible. Also, the bright special pricing signage could be used to lead the consumers towards healthier purchase choices when applying them to healthier products. Another study suggests that the research and development departments of manufacturers, and especially, retail companies, can support and encourage consumers

towards a healthier diet by influencing what to place on the shelves and how to present healthier breakfast cereals (Costa-Font and Revoredo-Giha 2019). Therefore, there exists an option to increase the marketing within the stores for healthier products (and breakfast cereals) from a retailer perspective instead of positioning and placing less healthy products more visible. In July 2021, the UK government announced that promotions on food and drinks high in fat, sugar and salt (HFSS) in retailers will be restricted from October 2022. Indeed, less healthy promotions will also no longer be featured in key locations, such as checkouts, store entrances, aisle ends and their online equivalents.

(iii) Reformulation

Another policy option is the reformulation of products, which is an indirect policy implication to change consumers into more healthy purchases without needing a behaviour change from them. Evidence shows that lowering the sugar content of the food and drinks through manufacturers could be a successful way of changing how much sugar is consumed by the consumers. A programme of reformulation to reduce the levels of sugar in all contributing food and drinks available would significantly lower sugar intakes, especially when accompanied by reductions in portion size (Tedstone et al. 2015). In 2018, Public Health England published a plan setting out details for the reduction and reformulation programme challenging the industry to reduce calories from "relevant foods" (i.e. high in sugar, salt, calories and saturated fat, such as ready meals, pizzas, snacks, sauces and dressings) by 20%, by 2024. A study finds that breakfast cereal manufacturers need to consider reformulation of their products in order to improve the healthiness through reducing sugar and increasing fibre (Potvin Kent et al. 2017b). Several food retailing chains across Europe announced voluntary initiatives to improve the overall nutrition on population level. Lidl, one of the largest European food retailers and discounters, is taking part in this initiative and plans on achieving this target through several changes; for example the promotion of healthier products, reducing the package size, reformulating as well as providing nutritional information and education (von Philipsborn et al. 2018).

(iv) Calorie / Sugar / Salt Reduction Programme

The UK Government commits to improving everyday food and drinks through structured and closely monitored programmes linked to Public Health England, specifically indicated in the Childhood obesity: A plan for action. They developed separate calorie, sugar and salt reduction programmes to encourage manufacturers to revise and reformulate their products and to lower calories but also reduce the sugar content in products, as it increases the risk of excess calorie consumption and weight gain leading to obesity in the long run. Sugar and calorie reduction and reformulation programmes aim to encourage food manufacturers to remove 20% of the sugar and calories in certain products by 2024 and challenges the food industry with substantial reformulation and/or portion size reduction. For instance, the UK "Sugar reduction programme" aims to reduce total sugar intake and where possible energy

without the increase of saturated fats and salt from the highest contributing food groups which include breakfast cereals by 20% by 2020. One key food group, which is mentioned in the sugar reduction proposal, is the breakfast cereal category due to the fact that adults and children eat them often daily.

Overall, to ensure success for the reformulation campaigns a collaboration between governments and manufacturers is needed to set realistic targets, but further consumers need to accept the change as well (Revoredo-Giha 2020). Research confirms that involving entire families in nutrition promotion programmes may represent another strategy for reducing socio-economic inequalities in diet and could lead to an increase in fruit and vegetable consumption (Ball et al. 2015). The success of reformulation strategy has been demonstrated in the UK through the implementation of a reduction programme of the salt intake. Salt reduction targets for 2024 have been developed based on the 2017 salt targets and consist of targets set per 100g of food for all sectors – retailers, manufacturers and the eating out, takeaway and delivery sector – in 28 broad product categories comprising 76 sub-categories of food and drink (UK Government 2020).

(v) Front-of-pack labelling

To promote healthier diets, regulatory authorities worldwide are encouraging the use of labels that provide simplified nutrition information on the front of the pack (FOP) additionally to the mandatory calorie and nutritional information that already has to be provided. The UK government tries to encourage healthier food choices through dietary education and one instrument is the front-of-pack-labelling "traffic light system" to support consumers making healthier food choices in-store based on the product's ingredients. In the United Kingdom, this government voluntary scheme uses colour-coded labels in red, amber and green to indicate respectively 'low', 'medium' or 'high' levels of total fat, saturated fat, total sugar and salt using red, amber and green colours to represent low, medium and high amounts of each nutrient. The UK Foods Standards Agency (FSA) identified the traffic light labelling as the most effective scheme and the FSA supported its use (Scarborough et al. 2015). Across Europe the most common FOPL is the Nutri-Score, a nutrition label that converts the nutritional value of products into a simple code of 5 letters, each with its own colour ranging from A to E and is based on the UK FSA model (El-Abbadi et al. 2020).

(vi) Soft Drinks Industry Levy

A more drastic measure that has been taken by the UK government to increase healthier food options is the introduction of a "sugar tax" on soft drinks. In 2018, the United Kingdom implemented a Soft Drinks Industry Levy (SDIL) is a levy on manufacturers of soft drinks with added sugar targeting all pre-packaged soft drinks containing at least 5 grams of added sugar per 100 ml of drink. Many soft drinks have already been reformulated and sales shifted to lower-sugar soft drinks resulting in a decrease by 28.8% of the average sugar content of drinks subject to the SDIL between 2015 and 2018. The sugar

tax has led to large scale reformulation of soft drink recipes, taking 45,000 tonnes of sugar out of the annual consumption from soft drinks (National Food Strategy 2020). The list of countries with taxes on sugar-sweetened beverages include: Belgium, Chile, Finland, France, Hungary, Ireland, Latvia, Mexico, Norway, Portugal, Spain, United Kingdom and the United States (at the sub-national level) (OECD 2019b).

However, it needs to be considered that without consumers embracing better dietary patterns, no measure from the policy tools above will create a strong impact because consumers want to be supported with information and tools that are more personalised (Revoredo-Giha 2020). To conclude on the role of policies, a consultation paper (UK Government 2020) from the UK government not only deals with an impact assessment of restricting volume promotions but also includes alternative policy options to restricting volume promotions for high fat, sugar and salt (HFSS) products. They mention for instance,

- Educating children through the curriculum on healthy eating,
- Public health campaigns,
- Using the front of pack nutrition labelling scheme to define HFSS food and drink (only allowing promotions of products that have a combination of green and amber ratings),
- A voluntary ban on promotions of HFSS food and drink
- Restricting temporary price reductions in addition to volume based (multibuy) promotions

Overall, this chapter aims to investigate whether the findings of this study support the UK and Scottish government plans to ban certain promotion types and to inform on further policy alternatives to increase healthier food choices beyond the UK shifting the focus towards a more global context and to encourage healthier eating from a policy perspective based on an OECD report written by the author of the thesis.

Implications for policies to promote healthier diets in OECD countries

An OECD report (Placzek 2021) aims to develop policies to encourage healthier food choices linked to socio-economic determinants of the consumers and a summary of the results will be presented in the following section. Chapter 6 of the thesis refers to “Implications for policies to promote healthier diets” (Section 5) “Socio-economic and demographic factors and policy effectiveness” (Section 5.5) of the report. It deals with socio-economic and demographic factors and their link to policy effectiveness. Section 5.2 of this thesis also refers to the OECD report on socio-economic determinants of food choices and investigates specific characteristics whereas this section links them to policy effectiveness when governments try to encourage healthier food choices.

Expanding the scope of this thesis, which looks at breakfast cereal purchases in Scotland, a bigger picture across countries including food choices in general, supports the aim of this chapter to investigate policies that encourage healthier eating. A wide range of policy instruments have been used

across OECD countries and are elaborated here. Based on the four track approach policies such as FOPL or food advertising restrictions can be categorised across a framework (Figure 6.3). It examines socio-economic and demographic characteristics of households influencing food choices and can support policy makers to tailor and target a specific policy mix efficiently across SES groups where less healthy purchases and consumption are most prevalent. It is structured around the OECD "four-track" policy approach to encourage healthier food choices (Giner and Brooks 2019) and around the findings of Placzek (2021) as illustrated in Figure 6.3. The first track consists of demand-side public interventions to tackle unhealthy food choices (e.g., education programmes or providing dietary information). The second track consists of voluntary collaboration with the food industry at the supply-demand interface (e.g., food reformulation, food labelling). The third track consists of firmer regulations when public-private incentives are misaligned (e.g., rules on advertising aimed at children), while the fourth track consists of fiscal measures such as placing consumption taxes on unhealthy products.

Figure 6.3 OECD four-track approach to promote healthier diets.

Source: Placzek (2021)

Demand-side policies of Track 1 underline the importance of household characteristics and SES groups because simply providing information for all consumers was found to have limited impact because lower SES are less likely to understand the information provided (e.g., on FOPL such as the traffic light system in the UK). Another important role is the constraint that the consumer faces (e.g. income, time) making it more difficult for households to achieve healthier food choices which are consistent with a healthy and recommended diet. Therefore, demand-side policies such as FOPL could play a key role by incentivising product reformulation, which is a supply-side policy way to increase the healthiness of a population as it allows consumers to effortlessly make healthier food choices without changing behaviour. However, reformulation cannot be used to promote greater consumption of, for example, fruit and vegetables, but at least possibly decreases the consumption of HFSS products through calorie, sugar or salt reduction programmes. Another way of including SES in policy making is found in Track 3. Firmer regulations can be implemented to protect consumers across various SES

groups such as restricting food marketing and advertising, in particular to children, for instance the Childhood obesity plans. Children from lower-income groups are found to be more exposed to advertising as well as screen time compared to higher-income groups. This finding has led to several OECD countries restricting television and online marketing of highly processed foods high in fat, sugar and salt targeting children and has been encouraged by the WHO. That underlines the importance of the thesis on investigating further how retail promotions influence (less) healthy food choices and linking the findings to socio-economic characteristics of households to improve policy making.

6.3.3. Research question and motivation

The third empirical chapter will apply a demand-side orientation using the household as a unit of analysis. This analysis looks at the scanner data from the consumer's perspective and how promotional offers influence the healthiness of purchases made by households. Household-level data enables to look at detailed socio-economic characteristics in the analysis as they will not be aggregated. This chapter will identify how retail promotions influence the healthiness of purchases of breakfast cereal products made by households and will provide insights on the full distribution from healthiest to least healthy purchases made across specific household characteristics. The aim of this research question is to investigate what factors influence the healthiness of purchases of breakfast cereals including the role of product and shop information but also the socio-economic characteristics of households. To address this aim, the study will categorise the products into healthy and unhealthy food using the UK FSA Nutrient profiling model in order to compare the influence of promotion types on purchases made by households of various socio-economic groups.

RQ3: What type of policies have the potential to encourage healthier breakfast cereal purchases?

a. Do retail promotions influence the healthiness of breakfast cereal purchases? What are possible factors that decrease the healthiness of those purchases?

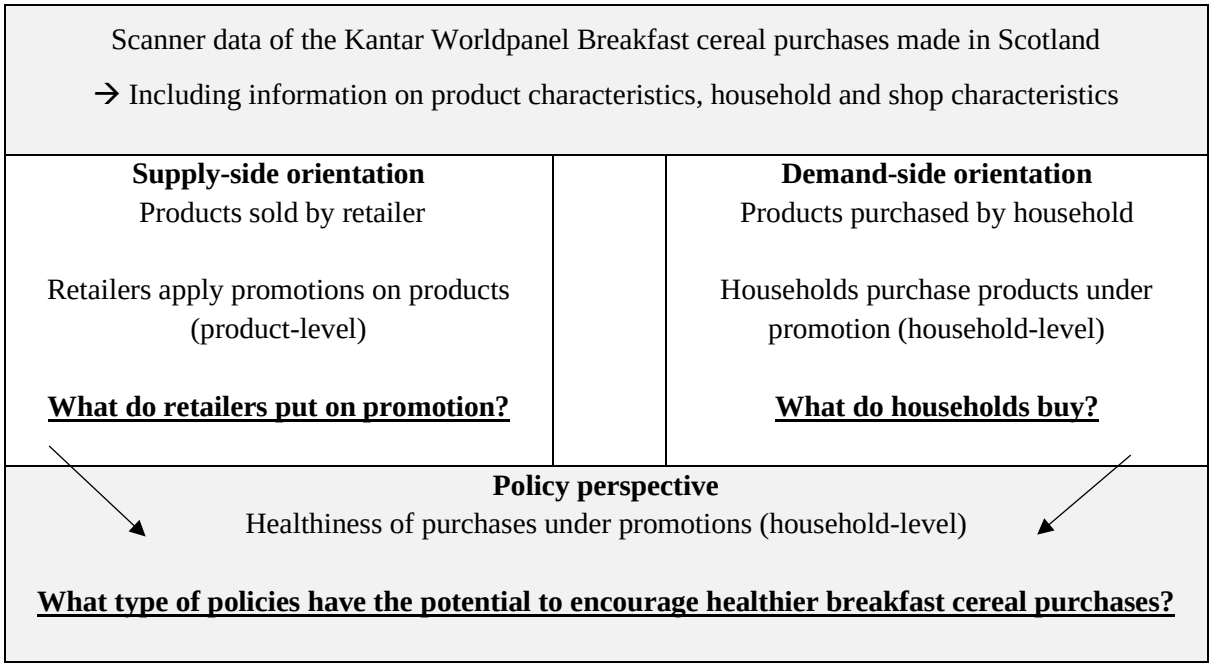
b. What type of policies might be successful in encouraging healthier breakfast cereal purchases?

What are the factors that increase less healthy food purchases? Do different promotion types lead to a less healthy diet? Which socio-economic characteristics of households might influence less healthy purchases? This analysis includes various promotion types and socio-economic characteristics of households but also looks at certain product characteristics such as the brand of a product or the weight of the package. This empirical chapter will investigate across the average healthiness of purchases by

the households based on the UK FSA score – from the healthiest to the least healthy consumers in terms of their breakfast cereal consumption.

Further, this chapter includes a policy perspective addressing how governments work on increasing healthier food purchases among populations. Adding the government's perspective to the thesis is necessary because one part of the obesity crisis in the UK is the overconsumption of HFSS and also the role of retail promotions on less healthy products as a major driver. Obesity is a major cause of ill health in England, increasing the risk of heart disease, stroke, type 2 diabetes, imposing a substantial burden and negative externality on the national health system and the wider economy in the long run. Government plans to rely on voluntary commitments to restrict promotions of HFSS food and drink have been very limited and unsuccessful in the past and therefore, further legislative intervention is necessary to ensure that retailers do not encourage excess purchasing and over consumption of less healthy food products. This research thesis tries to reveal the power of promotions from a supply and demand side and policies are needed that are able to align and incentivise changes, therefore this chapter as well as the results from the previous ones will be used to formulate policy implications (Figure 6.4.).

Figure 6.4 Research development towards Chapter 6.



Gap in the literature and contribution

Contribution to knowledge is ensured in this empirical chapter through including the different retail promotion types in the analysis but also including more information on the products purchased, the socio-economic households and shop information. Of key interest is how the healthiness of households is affected from the healthiest households to the least healthy ones. Due to the great diversity of household purchase behaviour linked to the healthiness of purchases, the OLS approach and therefore

the average healthiness is not sufficient when examining what influences unhealthy household only. Depending on the distribution of the healthiness, it is necessary to further observe the determinants affecting the purchases and consumption behaviour of the least healthy consumers. This empirical study therefore is extending the OLS regression by also including the estimation of a quantile regression model in order to give more insights on the quantiles across the distribution. The obtained results will provide information on the factors influencing the healthiness of purchases ranging from the healthiest households to the least health ones and can be used to design specific policy measures encouraging healthier diets on groups across different consumption levels. Therefore, this study employs a quantile regression to analyse the determinants of household breakfast cereal consumption for different levels of healthiness in Scotland and compare these results with the OLS regression.

However, limitations need to be addressed: This analysis deals only with breakfast cereals, including subcategories such as ready-to-eat-cereals, porridge oats, granola, muesli and instant porridge. Further, the UK FSA Score is used as an approximation and simplification to assess the healthiness of the household purchases. In the following section, the term "healthier and less healthy households" refers to the average UK FSA score of household purchases across one year in 2015 and is not addressing other parts of their diet except breakfast cereals. Further, the data offers purchase data only and not actual consumption. This thesis addresses the mentioned issue of data scarcity in the literature as this thesis uses Scanner data including purchase data with nutritional information and household information and only deals with breakfast cereals in Scotland for around 3,000 households.

6.4. Method and data description

The following section of the empirical chapter provides a description of the data set relevant for this research question, an explanation of the measurement variables and the method used to analyse the data and the results of the analysed data. Attention will be focused on the research method and data analysis. The previous chapters underline that retail promotions influence purchases and therefore the consumption. Knowing what factors affect consumption and how it is influenced by promotions has been analysed in the previous chapter as context analysis, whereas this chapter examines how promotions influence the healthiness of purchases and whether current policies use the right approach to critically review retail promotions. It will also report and analyse the results obtained from the descriptive statistics to achieve the research objectives. First of all, the chapter presents discussions of the descriptive statistics of the variables in the model while ensuring that the statistical assumptions are adhered to.

The Kantar Worldpanel dataset has a sample size of around 2,705 household panellists and is of sufficient size and representation to reflect the Scottish population in terms of their Scottish take home purchases providing a robust retail purchase dataset (Campbell et al. 2020). The empirical

analysis utilises the Kantar Worldpanel data set that includes household purchases in 2015 and adds information about product and shop information for each household. The unit of observations is the household and their average healthiness of breakfast cereals purchased during the year 2015. It is important to highlight that the product and shop variables are proportions as the data has been collapsed by household and therefore most product and shop characteristics are proportions across all purchases of each household. The results help to determine how the variation in predictors affects the healthiness of breakfast cereal purchases in the tails of the distribution and indicate the household's characteristics that lead to less or more breakfast cereal consumption. This analysis compares across average household healthiness and the influence of different factors such as purchases made under promotion types, but also household and product characteristics.

6.4.1. Quantile Regression

To answer the research question, the author is interested in the full spread of household's healthiness on their breakfast cereal purchases and this type of data used in the study also offers sufficient data across the full distribution allowing for the quantile regression method. The healthiness analysis provides useful insights of the variation of purchases across households and how they impact consumer diets. This model includes the average healthiness of households as the dependent variable, contributing to knowledge of the healthiest to the least healthy household. Also knowing what product characteristics decrease the healthiness such as branded labels or the size of the pack which is linked to the overall retail environment. Further, it informs on the most responsive household characteristics including the SES perspective given the household-level data. The insight on the full distribution of households according to their breakfast cereal purchases by healthiness, from the healthiest to the least healthy households is important for a policy perspective detecting critical characteristics such as the household size (families) or the level of deprivation, but also product and shop information to the influence on the healthiness across purchase behaviour. The OLS regression and quantile regression have been used in order to analyse the determinants of the healthiness of breakfast cereal purchases.

The OLS model is expressed as:

$$Y_i = \beta_0 + S_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + \varepsilon_i \quad (6.1)$$

where Y_i refers to the average healthiness of all breakfast cereal purchases by household *i*; β_0 is the constant term; S_i, P_i, and Z_i are the control variables; and ε_i represents the error term. Specifically,
S_i is the vector of all socio-economic household characteristics including *age, gender, number of adults, number of children, SIMD and rural accessibility;*

P_i is the vector of all product characteristics including the *proportions of purchases under price and volume promotions* and *branded* products, and also logarithms of the *weight* per package and the *full price* products;
Z_i is the vector of all shop characteristics including where purchases have been made across shop types, namely the *proportion of purchases made in discounters*.

The estimation model for this empirical chapter are the following:

$$Q_\tau(h_i) = \beta_0 + S_i\beta_1 + P_i\beta_2 + Z_i\beta_3 + \varepsilon_i \quad (6.2)$$

where h is the average healthiness of all breakfast cereal purchases by each household, τ denotes the τ th quantile in the distribution of the household's average breakfast cereal purchases.
S_i is the vector of all socio-economic household characteristics including *age, gender, number of adults, number of children, SIMD and accessibility;*
P_i is the vector of all product characteristics including the *proportions of purchases under price and volume promotions* and *branded* products, and also logarithms of the *weight* per package and the *full price* products;
Z_i is the vector of all shop characteristics including where purchases have been made across shop types, namely the *proportion of purchases made in discounters*;
ε_i is the standard error term.

To recap, the study includes proportions of values because the findings reflect the proportion purchased by households, which followed from collapsing the purchase data set by household level. For instance, all promotional variables are expressed in proportions. It can also be described also as percentages of purchases for example, out of 100% of household's purchases on average 0.63 (63%) have been bought under no promotion and 0.29 (29%) price promotion and 0.07 (7%) under volume promotion. The same applies for branded and private label products and the proportions of purchases made across supermarket types. Normal units of measurements are all socio-economic characteristics such as gender or number of adults as the data is household-level data. It is important to highlight that the promotion variables are measuring the proportion of a household's breakfast cereal purchases that are on promotion and examining whether a relationship exists for households who buy more of their breakfast cereals on price and volume promotion tend to purchase less healthy products. This analysis provides insights on which factors influence the average healthiness of purchases including promotion types and the independent variable groups are treated like control variables to better estimate the main effects of promotions.

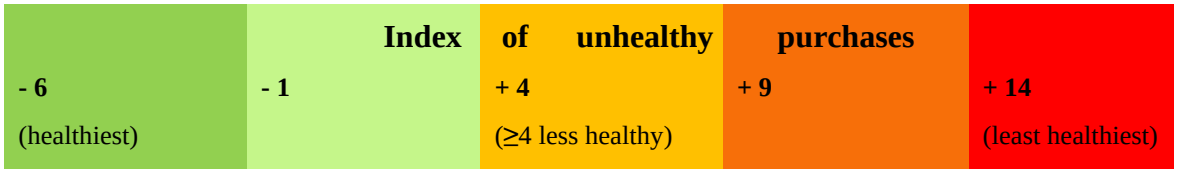
Table 6.2 Detailed parameter groups applied in the analysis (Chapter 6).

Dependent variable	**Average UK FSA score of households based on purchases**
Parameter group	Included variables
Product characteristics (weighted)	Proportion purchased under price promotion
	Proportion purchased under volume promotion
	Proportion purchased with a branded label
	Weight per pack (log)
	Full price per 100g (log)
	Weekly quantity purchase
Socio-economic household characteristics	Age of principal shopper
	Gender of principal shopper
	Number of adults
	Number of children
	Scottish Index of Multiple Deprivation (SIMD 1 -5)
	Rural accessibility
Shop characteristics (weighted)	Proportion purchased in shop "discounter"

6.4.2. Data description of household healthiness

The variable of interest in this study is the average healthiness of the household based on their annual breakfast cereal purchases. It is computed through the UK FSA health score applied to each product purchased by that household in 2015, which has been weighted by the number of products purchased, therefore the distribution of households is based on their breakfast cereal purchases by healthiness. The scoring scheme is defined as an "index of unhealthy purchases" of breakfast cereal which is based on a continuous scale of the UK FSA score ranging from -6 to +14. Figure 6.5. visualises the UK FSA score and underlines that products or households scoring 4 or more points it is classified as less healthy.

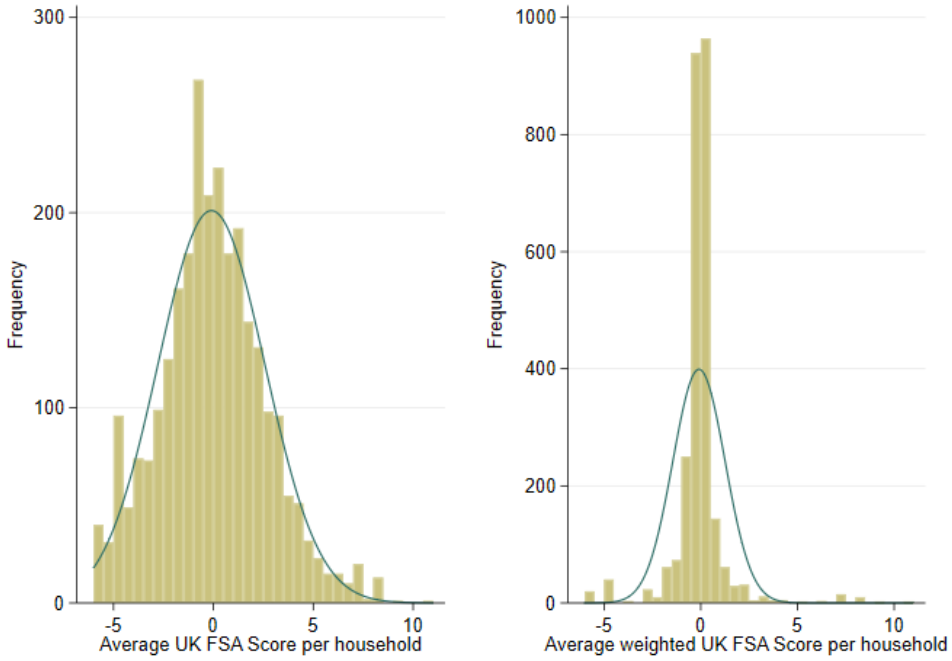
Figure 6.5 UK FSA Score linked to "index of unhealthy purchases".



The analysis uses the weighted average UK FSA of each household based on their annual purchases as the dependent variable and is compared to a simple average in Figure 6.5. To recap, weighted average is a calculation that considers the varying degrees of importance of the numbers in the given data set. Each number in the data set is multiplied by a predetermined weight (in this case a weighted product factor applied to the average UK FSA score) before the final calculation is made. In doing this, the weighted average is more accurate than a simple average in which all numbers in a data set are given

the same weight before summing them to a sole average value. Product and shop characteristics have been weighted due to the fact that the data was collapsed by household. Through using the frequency of how often a household purchased certain products across the year gave importance to the products that have been bought more frequent than others and therefore product characteristics are weighted averages. The same has been done for shop characteristics where households have been purchasing most through including the frequency and therefore stressing the importance of the shops where the household purchased more products than in others. For the UK FSA score, the weighted average includes information on the frequency of how often a certain product healthiness score was purchased across the full year of 2015. However, as shown in Figure 6.6. it does reduce the variety of scores.

Figure 6.6 Comparison average UK FSA Score versus average weighted UK FSA Score.



The following section illustrates different patterns in the data from a descriptive point, for instance providing an overview of the distribution of purchases across health and brand status, the distribution of promotion type purchases and where the purchases have been made across shop types.

Socio-economic household characteristics across household healthiness

Table 6.3 describes the maximum and minimum and means across different cuts of the dataset for several socio-economic characteristics and compares the mean of all households to healthy and less healthy households based on their average breakfast cereal purchases across 2015.

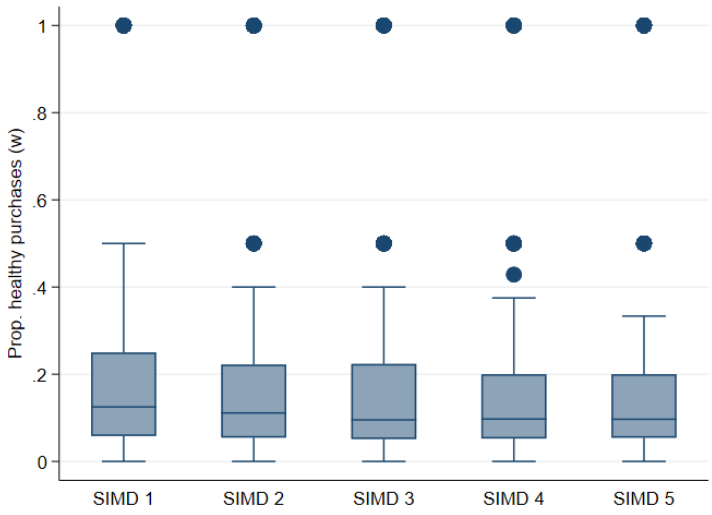
Table 6.3 Descriptive statistics of socio-economic characteristics by healthiness.

			All households	**Healthy households**	**Less healthy households**
Observations			2705	2522	183
Variable	Min	Max	Mean	Mean	Mean
Weekly quantity purchased	.019	5.233	.564	.568	.500
Female principal shopper	0	1	.744	.745	.727
Age of principal shopper	18	89	48.206	48.287	47.093
Number of adults	1	6	2.037	2.042	1.967
Number of children	0	6	.580	.569	.738
Average income in £	5,000	70,000	29,765.25	30,033.703	26,065.574
SIMD 1	0	1	.193	.190	.235
SIMD 2	0	1	.218	.216	.251
SIMD 3	0	1	.209	.208	.213
SIMD 4	0	1	.211	.213	.191
SIMD 5	0	1	.169	.173	.109
Rural accessibility	0	1	.220	.222	.197

Table 6.3 highlights key summary statistics of household characteristics. Overall, 74% of households have a female principal shopper**,** aged on average 48 years old and the average household comprises of about 2 adults live in a household with 0.58 children. The average household earns £29,765 per annum and the accessibility of 22% of households is categorised as rural (compared to urban). The SIMD classification from SIMD 1 (most deprived) to SIMD 5 (least deprived) is relatively equally distributed among the five groups ranging from 17 to 22% across the groups. The healthiness of households from a descriptive view is discussed in the chapter as part of the data description before the analysis of the UK FSA of household. Interestingly however is, that less healthy households have more children than healthy ones. They earn on average £26,065 (compared to £30,033 for healthy households) and are more urbanised than the average (19% compared to 22% of the healthy households). The SIMD distribution is different when comparing healthy and less healthy households – the greater proportion is found in the more deprived groups for less healthy households, namely 23% are SIMD 1 and 25% are considered as SIMD 2 (compared to healthy households 19% SIMD 1 and 21% for SIMD 2).

Figures 6.7 demonstrates further results obtained from the descriptive data analysis linking the healthiness of breakfast cereal purchases to SIMD as a measure of deprivation. The inspection of Figure 6.6 thus helps to compare across SIMD classification groups from the most deprived (SIMD 1) to the least deprived (SIMD 5). However, no big difference in the proportion of healthy purchases has been found indicating that the level of deprivation does not matter as expected when consumers purchase breakfast cereals, further insights will be given in the econometric analysis.

Figure 6.7 Proportion of healthy purchases by SIMD categories.



Product characteristics across household healthiness

Table 6.4 below describes the maximum and minimum and means across different cuts of the dataset for several product characteristics comparing all households to healthy and less healthy households.

Table 6.4 Descriptive statistics of product characteristics by healthiness.

			All households	**Healthy households**	**Less healthy households**
Observations			2705	2522	183
Variable	Min	Max	Mean	Mean	Mean
Prop. label private	0	1	.382	.391	.247
Prop. label branded	0	1	.618	.609	.753
Adds up to one			1	1	1
Prop. No promotion	0	1	.630	.637	.543
Prop. Price promotion	0	1	.298	.292	.385
Prop. Volume promotion	0	1	.071	.071	.071
Adds up to one			1	1	1
UK FSA (not weighted)	-6	11	-.099	-.504	5.492
UK FSA	-6	11	-.091	-.265	2.297
Weight pack	28.6	2000	571.181	573.366	541.062
Note: Weighted values are reported					

The product characteristics show that on average 61% of all purchases are branded products, purchases under no promotion are 63%, price promotion about 30% and 7% are volume promotion. Looking at the healthiness across these purchases, the average UK FSA score is -0.099 ranging from -6 to 11 (healthiest to unhealthiest), however the analysis will only make use of the weighted average UK FSA score. Again, the difference is highlighted in Figure 6.5. between average weighted and simply the

average UK FSA Score for each household. The different role of retail promotions can be already examined in the descriptive analysis as healthy household purchase more under no promotion (63.7%) compared to less healthy households (54.3%). Less healthy households purchase 38.5% under price promotion across their breakfast cereal purchases and 7.1% under volume promotion, a much higher price promotion use than for healthy households (29.2%). The descriptive statistics also highlight that among less healthy households, the proportion of branded products is higher (75.3%) compared to the healthy ones (60.9%). Further, less healthy households purchase on average smaller packages (541g) compared to healthier households (573g).

Shop characteristics across household healthiness

Table 6.5 describes the maximum and minimum and means across different cuts of the dataset for the shop characteristics. The shop information gives insights into where the healthy and less healthy consumers shop on average; 56% in major supermarket, 9% in convenience stores, 7% with online retailers, 25% in discounters and 3% in other shops. It highlights the importance of various shop categories and where consumers prefer to purchase e.g., that less healthy households purchase more in major supermarkets (57.8%) compared to healthy households (56.2%), convenience stores (11% compared to 9.1%) and more online compared to any other group. Interestingly the role of discounters highlights a great difference; less healthy households purchase on average 18.3% of their breakfast cereals in a discounter however healthy ones almost 26% in discounter, justifying exploring this variable further in the econometric modelling.

Table 6.5 Descriptive statistics of shop characteristics by healthiness.

			All households	**Healthy households**	**Less healthy households**
Observations			2705	2522	183
	Min	Max	Mean	Mean	Mean
Major supermarkets	0	1	.564	.562	.578
Convenience stores	0	1	.093	.091	.110
Internet retail	0	1	.066	.064	.097
Discounter	0	1	.254	.259	.183
Corner shops	0	1	.022	.021	.030
Other shops	0	1	.001	.001	.001
Adds up to one			1	1	1
Note: Weighted values are reported and in proportions purchases					

6.5. Empirical results

The results obtained and presented in this chapter are analysed comprehensively to help understand the relationship between the healthiness of breakfast cereal purchases and the influence of retail promotion types across weekly breakfast cereal purchases of 2015. It will further present evidence to establish the different effect across promotion types on (less) healthy purchases made by households. What factors influence the healthiness of household purchases? This analysis will not simply examine the consumption level, but investigate deeper what factors are associated with the healthiness of purchases. This is the overall contribution of the thesis because consumption itself is useful to explore the influences on purchases, but consuming is not harmful, whereas the healthiness of the purchased products plays a key role in tackling the obesity crisis among adults and children in the UK. Even more important are the insights on the healthiest and least healthy households – compared to simply examining the average healthy households.

This research aims to inform policy makers on how to increase healthier purchase especially among the least healthy consumers, but also to report on the factors that lead to less healthy purchases. That is why quantile regression is an appropriate tool in this empirical analysis to investigate the tails of the data and the spread of healthiness, but linear regression will be added as a comparison to highlight the advantages of quantile regression in answering the research question. Therefore, quantile regression supports developing a policy strategy through looking at the spread of healthiness by detecting the critical characteristics of unhealthy households. This analysis employs OLS regression and quantile regression to analyse the determinants of the healthiness of breakfast cereal purchases for different levels in Scotland, investigating the healthiest households up to the least healthy households across all their annual purchases. It shows the influence of a covariate (i.e., socio-economic characteristics or proportion of price promotions purchased) at various quantiles of the full distribution (Q.1, .25, .5, .75, .9) on the dependent variable (the average healthiness of purchased breakfast cereals in 2015 by each household). The empirical results from the quantile regression (QR) and OLS are presented in Table 6.6. Due to the number of independent variables in this study, they have been categorised across three groups of parameters to group the variables easier: product characteristics, household characteristics and shop information. Overall, the results and the interpretation of them will be used to answer the research question on what influences the healthiness of breakfast cereals purchases and which factors increase, and which decrease this average healthiness. The results of the OLS and QR will be explained along the following themes and parameter groups and therefore answer the research questions:

(i) Healthiness of breakfast cereals: Do promotions influence the healthiness of breakfast cereal purchases? Is the effect stronger for price or volume promotions?
(ii) Other interesting dimensions

(1) Socio-economic background of households: What specific household characteristics influence the healthiness of breakfast cereal purchases?

(2) Product information: What product characteristics affect the healthiness of breakfast cereal purchases?

(3) Shop characteristics: Does the shop type play a role among the healthiness of breakfast cereal purchases

The study examines the influence of socio-economic household characteristics, product characteristics and shop characteristics on the average weighted healthiness of household breakfast cereals purchases in 2015 across different quartiles on the basis of the healthiness of their purchases. In a broader perspective this analysis looks at an "index of unhealthy purchases" because this model uses the average weighted UK FSA health score of each breakfast cereal purchase by household and an increase in the dependent variable means an increase in the "unhealthiness" - the higher the UK FSA Score the more unhealthy the household. This will inform the debate what factors decrease the healthiness of consumers and will be linked to policy options to encourage healthier food choices later on in the chapter.

Table 6.6 presents the estimation results from the OLS and quantile regression. Results are discussed by promotion type, by product healthiness, and includes further interesting dimensions across all three parameter groups. The full table has been presented however only key results will be addressed according to the research questions and explained by themes. The quantile regressions estimated the associations between healthiness of breakfast cereals purchased and different determinants at the 10th, 25th, 50th, 75th, and 90th percentiles with robust SEs. The coefficient reported for each quantile are β values and are interpreted in the same way as in ordinary least squares regression (Hobbs and King 2018). All results need to be interpreted against the assumption that in the model all other independent variables are held constant and the empirical results show that the parameters vary across the OLS and quantiles. The dependent variable is the average healthiness of the household's breakfast cereal purchases computed through the UK FSA score of each product purchased across 2015 and calculated as a weighted average. The distribution of households according to their breakfast cereal purchases by healthiness can therefore be interpreted as the healthiest household to the least healthy households in the dataset. The following sections will describe the results of the OLS and QR results, which are divided into groups among all households:

OLS – mean healthy households

Q10 (10^{th} percentile) – healthiest households

Q25 (25^{th} percentile) – healthy households

Q50 (50^{th} percentile) – median healthy households

Q75 (75^{th} percentile) – less healthy households

Q90 (90^{th} percentile) – least healthy households

Table 6.6 OLS and QR estimates of the "healthiness model".

	OLS	Quantile Regression				
		Q10	**Q25**	**Q50**	**Q75**	**Q90**
	Mean healthiness	Healthiest households	Healthier households	median households	Less healthy households	Least healthy households
Socio-economic household characteristics						
Female principal shopper	-0.08905 (0.05779)	-0.00675 (0.02249)	-0.02308* (0.01388)	-0.04963*** (0.01534)	-0.04403*** (0.01703)	-0.01487 (0.03211)
Age of principal shopper	-0.00326 (0.00199)	-0.00172** (0.00074)	-0.00112*** (0.00042)	-0.00165** (0.00065)	-0.0013* (0.0007)	-0.00051 (0.00092)
Number of adults	0.0030 (0.03156)	0.01686** (0.0082)	0.01846*** (0.00487)	0.01922*** (0.00677)	0.01021 (0.01083)	-0.01225 (0.01187)
Number of children	0.02958 (0.03175)	0.00765 (0.00837)	0.0177*** (0.00427)	0.01776** (0.00802)	0.02172*** (0.00754)	0.03165*** (0.01133)
SIMD 1	0.09271 (0.08398)	0.01892 (0.03064)	0.03181** (0.01372)	0.04038** (0.0161)	0.04746** (0.01842)	0.02169 (0.02745)
SIMD 2	0.08122 (0.08095)	0.03192 (0.02308)	0.00829 (0.01536)	0.02755 (0.01826)	0.04633** (0.01974)	0.04282 (0.02657)
SIMD 3	-0.0029 (0.0832)	-0.00235 (0.02773)	-0.00471 (0.01269)	0.00529 (0.01561)	0.03167 (0.01985)	0.01975 (0.03837)
SIMD 4	0.01785 (0.08412)	-0.01104 (0.02962)	0.00011 (0.01519)	0.00375 (0.01231)	0.01567 (0.01981)	0.02175 (0.02331)
Rural accessibility	-0.04792 (0.06404)	-0.00652 (0.02394)	-0.00953 (0.0085)	-0.01215 (0.01443)	-0.03383* (0.0205)	-0.02085 (0.02331)
Product characteristics (weighted)						
Prop. Promo Price	0.49086*** (0.0963)	0.26012*** (0.05895)	0.2262*** (0.02343)	0.27628*** (0.03871)	0.24701*** (0.04282)	0.23023*** (0.07449)
Prop. Promo Volume	-0.08051 (0.16872)	0.20578** (0.09716)	0.04609 (0.04935)	0.03142 (0.0493)	0.11289 (0.07644)	0.16168** (0.07173)
Weekly quantity purchase	0.00041 (0.00128)	-0.00218** (0.00086)	-0.00129*** (0.00023)	-0.00099*** (0.00031)	-0.00009 (0.00031)	0.00225*** (0.00083)
Prop. branded product	0.29492*** (0.08719)	0.11987* (0.0643)	0.07813*** (0.02162)	0.07817** (0.03346)	0.02158 (0.04196)	0.0204 (0.06369)
Weight per pack	-2.22538*** (0.1702)	-6.07692*** (0.29966)	-5.0836*** (0.03794)	-2.97204*** (0.50237)	0.01954 (0.83197)	4.30635*** (1.14916)
Full price 100g	1.62333*** (0.21363)	-2.6002** (1.10038)	-0.11632 (0.18735)	0.84902 (0.53232)	3.41501*** (0.87867)	6.42033*** (1.12167)
Shop characteristics (weighted)						
Prop. Discounter	0.10604 (0.08814)	0.07551 (0.05586)	0.05239* (0.03067)	0.07982** (0.03324)	0.08187** (0.03442)	0.13154*** (0.04179)
Constant	-0.13072 (0.1647)	0.08174 (0.07869)	0.05293 (0.0338)	0.02954 (0.06045)	-0.07236 (0.05002)	-0.34859*** (0.07274)

Note:
The signs (***), (**) and (*) denote significance at 1%, 5% and 10% level respectively. Robust standard errors are presented in parentheses. All test results are not significant unless indicated otherwise through colouring underlining significant coefficients at one glance.

6.5.1. Healthiness by retail promotion types

(i) Promotional purchasing and average healthiness of households: Do promotions influence breakfast cereal purchases across healthy and less healthy households differently? (ii) Is the effect stronger for price or volume?

It is important to highlight that the promotion variables are measuring the proportion of a household's breakfast cereal purchases that are on promotion and examining whether a relationship for households who buy more of their breakfast cereals on price and volume promotion tend to purchase less healthy products exists. Several coefficients for the two promotion types were positive and significant indicating that the use of retail promotions (compared to no promotion) decreases the healthiness of the consumers. The greater the proportion of both price and volume promotions, the less healthy the household is on average. Both retail promotion types have the strongest and largest effect on the healthiest household encouraging less healthy purchases.

Promotional purchasing under price promotion on healthiness of households

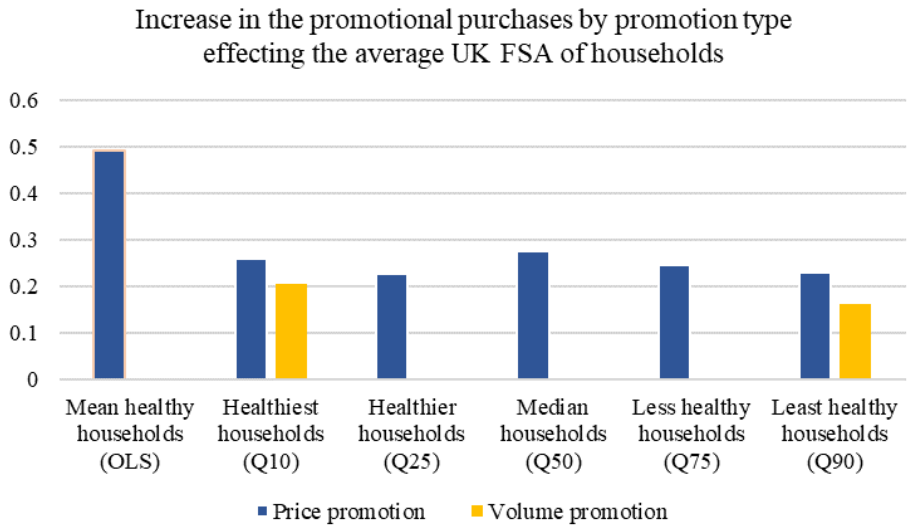
The estimates of the proportion for purchases made under price promotion are significantly positive across OLS and all quantiles. An increase in the proportion of products purchased under price promotion increases the average UK FSA Score – and therefore makes household purchases less healthy. The effect on the average healthiness is greater in the healthiest households (Q10) with a coefficient of 0.26 compared to 0.23 for the least healthy household (Q90). The strongest effect for the OLS (0.49) followed by the median household (0.27) and healthiest household (0.26). In other words, if all other characteristics are held constant, a change in the UK FSA of households is larger in a healthy household compared to an unhealthy household. Therefore, this promotion type increases the "unhealthiness" more among healthy households but also even stronger for the mean healthy household in the OLS model. The households that eat healthiest and "average healthy" are tempted by price promotions to decrease their average heath score with the strongest effect. Overall, two implications are revealed. One indicates that the greater the proportion under price promotion the less healthy are the households across both OLS and QR. Further, it indicates that price promotions are applied more to less healthy products – which has also been found in Chapter 4. The more promotions the households buy, the less healthy they become suggesting how retailer apply price promotions - an alarming sign to interpret that the already unhealthy households purchase even unhealthier as promotional purchasers. A reason for this behaviour might be that less healthy products under price promotions are preferred because consumers feel guilty when buying unhealthy products as a multi-buy in bulk (Mishra and Mishra 2011) and are therefore more responsive to price promotions which are more applied to less healthy products.

Promotional purchasing under volume promotion on healthiness of households

The greater the proportion of volume promotions purchased, the less healthy the household, which is a similar result for the price promotion variable. For volume promotions, the association has only been observed for the extreme households in the QR (the healthiest and the least healthy ones), however the stronger effect has been obtained for the healthy households in the 10th percentile (0.26) compared to the least healthy households in the 90th percentile (0.16). In other words, if all other characteristics are held constant, the promotional purchasers have a greater impact on the healthy households encouraging less healthy eating and that the healthiest households are impacted stronger than the already less healthy households through volume promotions. It is important to highlight that the volume promotions are linked to an increased quantity of products, so it not only increases the index of unhealthy purchases but also offers more products with one purchase increasing the risk of overconsumption. Overall, retail promotions influence all households ranging from the healthiest to the least healthy households differently. Overall, the results state, that price promotions have a similar effect across the healthiest to the least healthy households and are impacted the same by price promotion, which is not the case for volume promotions. The healthiest and least healthy households, which are only the extreme households in the distribution are impacted whereas the middle range of households seem to be unaffected by volume promotions. On the one hand it seems that they are more sensitive to volume promotions, but on the other hand, a reason could be that households in the middle (healthy, median, mean, less healthy households) purchase volume promotions on a mixture of healthy and less healthy products. Whereas the least healthy and most healthy households buy on volume promotion predominantly on less healthy products.

To sum up, Figure 6.8 underlines the significant size of the coefficients from the OLS and QR results. It compares the coefficients of the price and volume promotions across the healthiness of the households and shows that the strongest effect has been found for the OLS result as the proportion of price promotion increases, whereas the effect is relatively similar among the other quantiles. An increase in the proportion of volume promotion is significant only at the extremes of the distribution for the healthiest and least healthy households.

Figure 6.8 Comparison of coefficients of price and volume promotion.



6.5.2. Healthiness across further dimensions of parameter groups

(ii) Further interesting dimensions among three parameter groups

(1) Socio-economic background of households: What specific household characteristics influence the healthiness of breakfast cereal purchases?

The healthiness of household breakfast cereal purchases is affected by the gender of the principal shopper comparing female main shoppers to male ones. No OLS result shows significant estimates in any socio-economic household characteristics for this analysis. The quantile regression estimates however are significantly negative showing that female principal shoppers for the healthy, median and less healthy households purchase more healthy breakfast cereal products on average. Therefore, female principal shoppers are more sensitive to healthier purchases and they increase the overall healthiness of the household and decreases the "index of unhealthy purchases", except in the least healthy households where it is needed most.

The age coefficient of the principal shopper is negative and statistically significant across four quantiles indicating that older consumers purchase healthier breakfast cereals among all households except for the least healthy ones.

The variables dealing with the number of adults and the number of children are significantly positive across different percentiles of the quantile regression and show that the size of the household including adults and children impacts the healthiness of breakfast cereals purchases in a negative way. Among the least healthy households, having an additional child has the strongest impact on the healthiness and decreases the healthiness of the already unhealthy households even more. The children effect is stronger in the upper quantiles than in the lower quantiles and almost double comparing Q25 to Q90. It underlines the highly important role of the healthiness across breakfast cereals for families

especially the more children they have and the unhealthier the households are impacting the diet of children. Evidence shows that breakfast cereals producers and retailers are targeting children with advertising and therefore influence parents' purchases trying to satisfy the wishes of their children, which again supports the danger of promoting less healthy products, especially among large families with several children shaping their preferences and diet at an early stage. Nevertheless, it needs to be considered that larger households might depend on volume promotions.

The Scottish Index of Multiple Deprivation (SIMD) is significantly positively in the lower groups compared to the least deprived households. The more deprived a household is, the less healthy breakfast cereals they purchase on average. The result might indicate that not just income but also other dimensions of deprivation (e.g., education) matters when choosing breakfast cereals in the retail environment.

Another household characteristic deals with the place of residence. A rural household compared to urban located households, impacts the healthiness of households. The effects of being a rural household on the healthiness of households are significantly negative only for the less healthy households. It indicates that living in rural areas among less healthy household makes them more healthy compared to urban households.

(2) Product information: What product characteristics affect the healthiness of breakfast cereal purchases?

Purchases of branded and private label products also influence the healthiness of purchases. The proportion of branded products purchased compared to private label product does affect the healthiness of a household and increase the index of unhealthy purchases. As the proportion of branded products increases, the UK FSA score increases among the mean households strongest (OLS), but also among the healthiest to median households. Therefore, the more branded product they purchase, the less healthy the average healthiness of the household is.

The weight of the package is negatively associated with the index of unhealthy purchases across OLS and Q10 Q25 and Q50. This suggests that the bigger the package of the breakfast cereal the more healthy the purchases of household are. Therefore, the healthiness of a household increases with bigger packages – a very strong effect and is gradually decreasing from Q10 to Q50. This is explained in the thesis in previous sections, as larger breakfast cereals packages are often healthier products for instance less processed porridge oats and also that less healthy household do purchase on average less heavy packages. However, the sign of the estimates changes in the QR for Q90. A positive estimate has been found for the least healthy households – an increase in the package size increases the health score and makes purchases less healthy.

(3) Shop characteristics: Does the shop type play a role among the healthiness of breakfast cereal purchases

The healthiness of a household is also affected by the place where they shop their breakfast cereals, and this analysis includes the variable "discounter" compared to all other shops. This variable includes various chains such as Lidl and Aldi. The coefficients for proportion of breakfast cereals purchased at discounters are positive and significant in four quantiles (except for the healthiest households), suggesting that an increase in products purchased in discounters makes purchases less healthy. The effect is twice as strong for the unhealthiest households as for the healthy ones.

6.5.3. Robustness test

In this section, the robustness of the obtained results is assessed through the following exercises. First of all, a critical econometric issue arising in estimating the empirical model is that the right-hand side variables in equation (6.2) and may not be exogenous. Overall, the tests were carried out for robustness purpose and to deal with possible biases towards the analysis of the average healthiness across households used in testing the relationship between various factors.

Robustness Test: Variance Inflation Factor

To check for multicollinearity, Variance Inflation Factor (VIF) is applied. It is used to measure the degree of multicollinearity in the model and as there are many variables in quantile regression model, they might be highly correlated. Including highly correlated variables can lead to biased and unstable estimation of regression coefficients but also increase the variance and standard error of coefficients, and overall reduce the statistical power of the model. The VIF test was carried out to measure how inflated the variance of a slope is as a result of the non-orthogonality of the independent variables above the expected variance should the variables be uncorrelated. VIF greater than 5 indicates high multicollinearity and 1/VIF not smaller than 0.1.

Table 6.7 shows variance inflation factor test carried out to determine the multicollinearity and possible correlation between the variables used in model. The Variance Inflation Factors are smaller than 5 for both models and it reveals that all independent variables can be used as they are not correlated to the dependent variable "average healthiness". The highest value of VIF is 1.922 and is still below the standard threshold of VIF of 5. This is an indication that there is no need to remove any independent variable as there is no evidence of strong multicollinearity.

Table 6.7 Variance Inflation Factor test for Multicollinearity .

	VIF	1/VIF
SIMD 4	1.922	.520
SIMD 3	1.864	.537
SIMD 2	1.825	.548
SIMD 1	1.794	.557
Label branded	1.515	.660
Full price 100g	1.452	.689
Weight pack	1.410	.709
Quantity purchased	1.356	.737
Children	1.349	.742
Discounter	1.332	.751
Age	1.287	.777
Rural	1.148	.871
Promotion Price	1.142	.876
Promotion Volume	1.105	.905
Adults	1.047	.955
Female	1.037	.964
Mean VIF	1.412	.

Robustness Test: Matrix of correlations

However, before concluding on whether to include all the variables in the models, a pairwise Pearson‘s correlation matrix was also run. Correlations is often used to explore the relationship among a group of variables. The output gives correlations for all the pairs of variables and each correlation is produced twice in the matrix (Table 6.8). Pearson’s correlation coefficient measures the strength of the association between two variables and are repeated under the number 1 in the diagonal. This value can range from -1 to 1. Table 6.8 describes the pairwise correlation of all variables in the correlation matrix. The resulted correlations allow in this analysis to introduce all variables across the different parameter groups.

Table 6.8 Matrix of correlations.

Matrix of correlations Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) WUK_FSA	1.00000																
(2) Female	0.00301	1.00000															
(3) AGE	-0.06064	-0.11895	1.00000														
(4) NUMADULT	0.02872	0.06079	-0.03215	1.00000													
(5) CHILD	0.06218	0.15403	-0.43234	0.06966	1.00000												
(6) SIMD_1	0.01850	-0.00688	-0.09945	-0.03655	0.02217	1.00000											
(7) SIMD_2	0.02002	-0.00371	0.01086	-0.02658	-0.03657	-0.25886	1.00000										
(8) SIMD_3	-0.02146	-0.00775	0.00218	0.00584	-0.02949	-0.25128	-0.27138	1.00000									
(9) SIMD_4	-0.00023	0.00431	0.01326	0.03261	0.02960	-0.25325	-0.27350	-0.26549	1.00000								
(10) rural	-0.01856	0.00657	0.03761	0.04226	0.04598	-0.17862	-0.11015	0.15366	0.25676	1.00000							
(11) WDpromo_Price	0.13446	0.02274	-0.06926	0.00726	0.07575	-0.00943	0.00618	-0.01224	0.06083	0.02094	1.00000						
(12) WDpromo_Volume	0.00960	0.00163	-0.06570	0.01345	0.05044	-0.00942	0.03660	-0.02785	-0.02560	-0.00931	-0.13679	1.00000					
(13) quantity_purc~d	0.04475	0.05014	-0.01112	0.16061	0.22460	-0.09475	-0.01045	-0.00441	0.03287	0.05267	-0.00628	0.08472	1.00000				
(14) Wlabel_branded	0.13278	0.01490	0.04224	0.05569	-0.04386	0.01091	0.00746	-0.01373	0.01363	-0.01504	0.25931	0.16449	-0.10899	1.00000			
(15) Wweight_pack	-0.21775	-0.10202	0.06065	-0.13551	-0.18589	0.06403	0.00785	0.00305	-0.03382	-0.03643	-0.03473	-0.09843	-0.39818	-0.02659	1.00000		
(16) Wfull_pric~100g	0.05649	-0.04364	0.00875	-0.09738	-0.15381	0.06128	0.02210	0.00263	-0.03319	-0.05129	0.03094	-0.05505	-0.39781	0.23521	0.44640	1.00000	
(17) Wdiscounter2	-0.04634	-0.02098	0.01766	0.00722	0.01662	0.03921	0.02419	-0.01841	-0.00465	-0.00824	-0.17559	-0.13077	0.03702	-0.48106	-0.00947	-0.14216	1.00000

6.6. Discussion

Do retail promotions influence the healthiness of breakfast cereal purchases? What are possible factors that decrease the healthiness of those purchases?

This study employs OLS regression and quantile regression to analyse several factors affecting purchases for different levels of the healthiness across breakfast cereal purchases in Scotland. Scanner data from 2015 by Kantar Worldpanel are used and the analysis investigates how retail promotions and several socio-economic, product, and shop characteristics impact the healthiness of breakfast cereal purchases across different levels. Features of the data include information on 2,705 households that purchased overall more than 1,000 breakfast cereal products across the year 2015. The results of the analysis are summarised as follows.

First, more determinants that significantly affect the healthiness of household purchases are derived in the quartile regression analysis compared to the OLS estimates. The quantile regression shows that the association varies significantly across the conditional average household's healthiness distribution. The OLS model overstates (understates) the effect of household characteristics on the healthiness of households at the lower (higher) half of the distribution. This is for instance the case for the variables on the promotion types, but also socio-economic characteristics are not significant in the OLS model whereas some are significant in the QR. This suggests that conclusions from standard models (e.g., OLS) that assume uniform response across different quantiles of the distribution may be misleading. For instance, the volume promotion variable is not significant in the OLS and therefore it would be concluded that volume promotions have no effect on the average household, but more importantly the QR highlights that the least healthy households are affected strongly by them and are important to include in policy work. Therefore, quantile regression supports developing a policy strategy through looking at the healthiness of purchases by detecting the critical characteristics of also the least healthy households. It has been found that the responses of household food purchases to a specific predictor may vary across the bottom and top quantiles. In addition, it is possible to analyse the healthiness of breakfast cereal purchases across different household groups in the quantile regression – from the healthiest households to the least healthy ones.

Promotional purchases influence the average healthiness of households and therefore their diet

Based on the estimated results, the analysis identified the characteristics of the healthiest to the least healthy households. Factors such as both retail promotion types (price and volume promotions) but also the household size have a great impact on the increase of the 'unhealthiness' of purchases. The strongest effect for high promotional shoppers (as referred to by Campbell et al. 2020) are decreasing their healthiness across both promotion types – the price and volume promotions. The least healthy households respond to both types, and strategies for encouraging healthiness of those households should focus on specific groups that already eat unhealthily and are encouraged to eat even unhealthier through

the attraction to retail promotions. The analysis shows that purchases under price and volume promotion increase the index of unhealthy purchases of a household's breakfast consumption. However, price promotions have a similar effect across the healthiest to the least healthy households and affect the full range of households and encourage them all to eat less healthy. For volume promotional purchasers, the healthiest and least healthy households are encouraged to buy predominantly unhealthy products, the rest purchases a mixture of products across healthy and less healthy ones. Nevertheless, the least healthy households are buying less healthy products as a multi-buy increases the danger of overconsumption and obesity in the long term.

The significant household characteristic, which indicates a less healthy diet is the household size and therefore the number of adults and children living in a household – the bigger the family the higher the index of unhealthy breakfast cereal purchases. Regarding product characteristics, it is important to mention that as the proportion of branded products increases and so does the average full price of the products, an increase in the average 'unhealthiness' of household across the year has been found. An increase in discounter purchases also increases less healthy breakfast cereal consumption among all households. One reason could be that discounters apply a different strategy than for instance supermarkets including the reduced use of price promotions as they try to target low socio-economic status consumers with constantly lower food prices. These tend to be more price sensitive but also might be associated with lower levels of education e.g., knowing how to prepare healthier breakfast cereals, but rather purchase less healthy breakfast products across the full distribution of households. However, female and also older principal shoppers, but also less deprived/wealthier and rural households purchase on average more healthy products. Besides, purchases of heavier products indicate a better healthiness among most households. The specific factors that increase the index of unhealthy purchases among the key variables with regard to (i) promotion types, (ii) socio-economic, (iii) product and (iv) shop characteristics are illustrated in Table 6.9.

Table 6.9 Overview key results from analysis impacting the index of unhealthy purchases.

	OLS	Quantile Regression				
	Mean healthiness	Healthiest households	Healthier households	Median households	Less healthy households	Least healthy households
		Index of unhealthy purchases				
Price promotion	+	+	+	+	+	+
Volume promotion		+				+
Number of children			+	+	+	+
SIMD1 (most deprived)			+	+	+	
Branded products	+	+	+	+		
Weight per pack	-	-	-	-	-	+
Discounter			+	+	+	+

Note: + and – represent the sign of the estimated coefficients based on the result of the Table 6.6. "+" indicates a positive association between the index of unhealthy purchases (purchasing less healthy) and the independent variable, whereas "–" indicates a negative association between the index of unhealthy purchases (purchasing more healthy) and the independent variables.

Overall, how can these results be used to push the least healthy households? Female and older principal shoppers usually purchase healthier breakfast cereals, however, both age and gender effects vanish among the least healthy households. Interestingly, the only significant socio-economic characteristic is the number of children, which exerts the strongest effect among all households, alarming that having more children leads to even unhealthier purchases among the least healthy households. Overall, no variable influences the least healthy households to increase their average healthiness based on the estimated results from the model. One way might be to reduce price and volume promotions because most promotions are applied to less healthy products and therefore might lead to healthier purchases when retailers are restricted to apply promotions to less healthy products.

However, two sides of the coin need to be investigated – not only are consumers influenced by retail promotions, but also retailers apply promotions to certain products. Based on supply-side information from Chapter 4, Table 6.10 underlines through product-level data that promotions are more applied on less healthy products and therefore the more households purchase under promotion the more they purchase less healthy products. 23.4% of price promotions more applied by retailers (and purchased by consumers) to less healthy products compared to 18.6% on healthy products. Whereas 5.9% of volume promotions are used on healthy products and 5.4% on less healthy breakfast cereals. This explains the finding of the analysis why an increase in the proportion of price promotions increases the unhealthiness among all households "automatically". However, the results of an increase in volume promotions provides a mixed picture as the UK FSA Score does not increase among all households but only at the extremes (healthiest and least healthy households). Overall, it reveals that less healthy products are generally promoted more (28.8%) compared to healthy ones (24.5%). The results again

stress the need to not only investigate both supply and demand-side but also differentiate among promotion types and healthy status underlining the key contribution to the literature of this thesis.

Table 6.10 Proportional purchases across health status of products by mean.

	All	**Healthy**	**Less Healthy**
Products	**1,122**	**913 (81%)**	**209 (19%)**
Proportion no promotion	0.747	0.755	0.712
Proportion on promotion	0.253	0.245	0.288
Proportion price promotion	0.195	0.186	0.234
Proportion volume promotion	0.058	0.059	0.054

A practical example is given in this discussion section, to underline the role of promotions and the link to the healthiness of food products with a real household-specific example. To show the effect in a change in the diet that is needed to balance out how promotions impact the purchases is underlined through an example in Table 6.11. The effect of price promotions (a one percent increase in proportion) was estimated to increase the UK FSA score by 0.23 points, and alternatives of specific breakfast cereal products are given to show how the diet of a household has to change to not let price promotions decrease their healthiness of purchases. This can be reached through a combination of products and different options to decrease the score as highlighted in Table 6.9 and underlines the magnitude of the effect that is a needed to change the diet (for the average healthiness across one year). For example, Option 1 shows that on average a least healthy household that buys only less healthy products across the year, can switch to a healthier and similar alternative of its preferred product (product UK FSA score of 4 instead of 7), which increases the average healthiness to 3 UK FSA points healthier and is an equivalent of a 10% decrease in price promotion proportion. It clearly translates the effect of price promotions to a practical context as a comparison.

Table 6.11 Healthier breakfast cereal alternatives for a least healthy household.

Household	746479
Socio-economic household characteristics	
Sex	Male
Age	57
Household size	1
Number of children	0
Average annual income	£35,000
BMI	36.4 (obese)
Accessibility	Rural
SIMD	4
Health status across annual purchases	UK FSA 7 (less healthy)
Product information on purchases made in 2015	
Purchased product	Kellogg's Crunchy Nut Cornflakes 750gr (433579)
Quantity purchased	12 packs (with 9 shopping trips)
Purchases made under	No promotion: 0% Price promotion: 100% Volume promotion: 0%
Average price discount (depth of discount)	£0.45 per pack
Subcategory	RTEC
Brand status	Branded
Weight per pack	750gr
UK FSA	7
Shop information	
Bought in	Tesco (7x), Tesco Extra (1x), Asda (1x)
Based on QR estimates: A 1% increase in the proportion of price promotion increases the UK FSA among the least healthy households by 0.23 points…	
Household purchased 100% of least healthy products of Kellogg's Crunchy Nut Cornflakes (12x per year)	UK FSA 7 (on average across the year)
Healthier alternatives	Nestle Shredded Wheat (UK FSA -6) Lidl Honey Nut Cornflakes (UK FSA 1) Kellogg's Crunchy Nut Cluster (UK FSA 4)
<u>Option 1</u> Switching 100% of products to a 'healthier alternative' (e.g., Kellogg's Crunchy Nut Cluster (UK FSA 4))	UK FSA 4 (on average across the year) → 3 UK FSA points healthier **(equivalent of a 10% decrease in price promotion proportion)**
<u>Option 2</u> Switching 50% of products (6x per year) to a 'healthier alternative' (e.g., Kellogg's Crunchy Nut Cluster (UK FSA 4))	UK FSA 5.5 (on average across the year) → 1.5 UK FSA points healthier
<u>Option 3</u> Switching 50% of current purchases to the 'most healthy' alternative (6x per year) (e.g., Nestle Shredded Wheat (UK FSA -6))	UK FSA 0.5 (on average across the year) → 6.5 UK FSA points healthier
<u>Option 4</u> Switching 1x product per year to a 'healthier alternative' (e.g., Lidl Honey Nut Cornflakes (UK FSA 1))	UK FSA 6.5 (on average across the year) → 0.5 UK FSA points healthier **(equivalent of a 2% decrease in price promotion proportion)**

What type of policies might be successful in encouraging healthier breakfast cereal purchases?

Possible policies regarding retail promotions encouraging healthier breakfast cereal purchases

Overall, the results show that policies need to target and protect the least healthy households as they made less healthy purchases irrespective of price and volume promotions. As the least healthy households are responsive to both price and volume promotions, a policy approach might be to encourage price reductions and multi-buy offers on healthy products only and the results support the evidence based on academic literature but also government reports: A restriction of retail promotions on less healthy products seems to be a successful tool as this study confirms. The role of retail promotions and different types is important – both types target the healthiest households. One with price promotions experimenting with new products, whereas the volume type targets the unhealthier consumers with familiar multi-buys increasing overconsumption.

Price promotions decrease the healthiness of household purchases the strongest among both promotion types, and have a significant association among the full spread of household's average healthiness. Purchases with a greater proportions of price promotions have been found to be significantly increasing unhealthier purchases among all household. However, the effect is strongest among the healthiest households indicating that the healthiest consumers might be encouraged to purchase less healthy products under price promotions. It indicates that price promotions lead to experimenting with unhealthy products and "trying the forbidden fruit".

Distinguishing by promotion type is crucial as another essential feature is addressed through volume promotions. They do not just increase the consumption but also lead to stockpiling and overeating because the promotional offer is linked to an increase in the quantity which leads to faster consuming after stockpiling. In a way, volume promotions target the unhealthiest to become even unhealthier and can be interpreted as a "buy one get another unhealthy one for free". Often multi-buy promotions are not used to try new products but to purposely increase the quantity of a certain product that the consumer already knows and likes and lead to more purchases than the consumer intended to buy or may need, just to make use of the promotional offer, which again incentivises overpurchasing and overconsumption. Another important finding is the role of families (particularly the number of adults and children) among the healthiness of consumers. The bigger the family, the less healthy they buy breakfast cereals. It is an important policy implication as governments try to fight childhood obesity whereas the study shows that families with more children eat unhealthier breakfast cereals. This supports the reformulation plans of the government for example in the Childhood Obesity Plan. To use the findings to improve the food environment – promotions could be used to increase the healthiness of households and lead to buying healthy breakfast cereals. Price promotions could be used to experiment with healthy products and volume promotions applied to healthy products that are familiar and liked can still offer households the opportunity to save money through a deep discount. When aiming to improve the poorest household's diets the most and they purchase promoted products because of the

monetary saving then applying promotions to healthy products might be one solution to increase their consumption of healthier products.

6.7. Conclusion

Overall, this empirical chapter examines the role of different retail promotion types on encouraging healthier breakfast cereal purchases and based on the result gives practical implications and insights for policy makers. The empirical analysis in this chapter utilises the Kantar Worldpanel data set that includes 2,750 households in 2015 and analyses the average healthiness of breakfast cereals purchased during the year 2015 by each household. A summary of the empirical results and possible policies regarding retail promotions encouraging healthier breakfast cereal purchases have been presented.

The strongest effect for the price and volume promotion has been found on the healthiest households. Also, the least healthy households respond to both promotion types, and strategies for encouraging healthiness of those households should focus on specific groups that already eat unhealthily and are through the use of promotions encouraged to eat even unhealthier. Price promotions decrease the healthiness of household purchases the strongest comparing among both promotion types, but also it has a significant association among the full distribution of households. Distinguishing by promotion type is crucial as another important feature for consumers is addressed through volume promotions. They do not just increase the consumption but also lead to overconsumption because the promotional offer is linked to an increase in the quantity, and this leads to faster consuming after stockpiling. It is an important policy implication as governments try to fight childhood obesity knowing that families with more children eat unhealthier breakfast cereals.

To use the findings to improve the food environment, promotions could be used to increase the healthiness of households and lead to buying healthy breakfast cereals. Price promotions could be used to experiment with healthy products and volume promotions for the healthy products that are familiar and liked and still offers households the opportunity to save money through a deep discount. When aiming to improve the poorest household's diets the most and they purchase promoted products because of the monetary saving then applying promotions to healthy products might be one solution to increase their consumption of healthier products. Figure 6.9. shows a graphical summary of key findings from this empirical chapter.

Figure 6.9 Graphical summary of key findings from Chapter 6.

Chapter 6 **Policy orientation**	**Factors that influence healthiness of breakfast cereal purchases…**	
	Increases healthiness	**Decreases healthiness**
Price promotion		
Volume promotion		
Socio-economic characteristics		
Older principal shopper		
Female principal shopper		
Larger household size		
Rural households		
Most deprived households		
Product characteristics		
More expensive product	* healthier households	*less healthy households
Weekly quantity purchased	* healthier households	*less healthy households
Larger package size	* healthier households	*less healthy households
Branded product		
Shop characteristics		
Discounter		

Further, the chapter includes insights based on an OECD report written by the author of the thesis on socio-economic determinants of food choices and policy effectiveness. It concludes that to tackle the obesity crisis and to fight malnutrition in developed countries, a broad approach is needed consisting of demand-side public interventions, voluntary collaboration with the food industry at the supply-demand interface, firmer regulations when public-private incentives are misaligned but also including fiscal measures. To create an effective policy mix, specific targeting among socio-economic groups has to be included.

To conclude, the findings of this study support the UK and Scottish government plans to restrict the use of retail promotions on less healthy products, as promotional purchases decrease the healthiness of purchases made by households and therefore policies that target banning volume promotions might be a successful way to encourage healthier dietary patterns especially among breakfast cereals purchases. However, this study is not without limitations. First, this study represents a Scottish sample only and one part of the breakfast diet based on take home retail purchases excluding out of home consumption. It focusses on the purchases made in the supermarket and does not consider waste in the

households for example losses during cooking or food which will be thrown away, which means that this study does not analyse consumption data but purchase data. Second, the estimated prevalence of price promotions is based on the percentage of sales, rather than on the percentage of foods that are available for consumers to purchase. This characteristic of the data is important, since the retail environment is better characterised by food availability data than food sales data. Third, the purchased price promotion represents that the promotion has been purchased in the supermarket, but it does not include the combined effect of other influence on the purchase such as the frequency and duration of the promotion, the competition of other retailers and manufacturers. In future research, these limitations could be addressed.

Chapter 7

7. Discussion and conclusion

7.1. Introduction

An unhealthy diet is associated with obesity among adults but also children and is linked to negative health outcomes, which are correlated with differences in behaviour across socio-economic groups. Obesity costs the UK National Health System £6 billion a year and accounts for 5% of its budget. While the reasons for the obesity problem are complex and less healthy dietary patterns play a crucial role, the fact that consumers purchase the majority of their food from retailers suggests that food marketing influences the diet and strongly promotes ultra-processed foods. One common marketing tool used for food products are retail promotions, as price is a key determinant of food choice among consumers, especially among low-income households who are more sensitive to for example price-lowering strategies such as a price reduction.

The COVID-19 pandemic served to highlight many of the extent problems. The high obesity rates and diet-related diseases contributed to the strong impact of the COVID-19 crisis on the UK. Obese people with COVID-19 are 150% more likely to be admitted to intensive care, and severely obese people over 300%. The poorest in society are impacted even more because obesity is more prevalent in the lowest income groups compared to the highest. Further, childhood obesity is also strongest among the poorest and it has been found that the poorest children are three times more likely to be obese than children from richer neighbourhoods (National Food Strategy 2020). The COVID-19 crisis challenged the whole food systems from supply to distribution. Supermarkets shelves were empty because people started to stockpile as the virus appeared and supply lines were struggling to deliver when people "stayed at home" and the out of home food sector was shut down temporarily. The COVID-19 outbreak highlighted the important role of the overall retail sector as the grocery sector grew by 11% within one month (National Food Strategy 2020). More than ever the crisis emphasised the importance to increase

the healthiness of the consumer diets – and part of the solution based on the findings from the thesis is to restrict promoting less healthy foods and beverages. However, the consequences of the pandemic offered a chance to collect more data on household purchases as there was no possibility to consume food-away from home in restaurants, pubs or cafes, which normally accounts for 20-25% of UK calories (Campbell et al. 2020). This changed consumer behaviour and eating habits, and for instance, the delivery schemes, corner shops and local food retailers were able to all increase their share of the market (National Food Strategy 2020). Overall, the COVID-19 crisis highlights the importance of this thesis; the influence of retailers on food purchases, the need to tackle the obesity crisis, and the significance to examine across socio-economic groups.

Against this backdrop, the aim of this research is to analyse the influence of retail promotions on the healthiness of breakfast cereal purchases. Specifically, the focus lays on the distinction of promotion types as well as consumers' purchase behaviour of healthy and less healthy breakfast cereals in Scotland. This study investigates retail purchases made under different promotion types through the lens of the retailer and also from the consumer's point of view.

After setting out the research background, research motivation and research questions in Chapter 1, this thesis starts with a literature review on obesity and unhealthy diets, which is closely linked to the increased consumption of ultra-processed foods (Chapter 2). Next, the retail environment in the UK with a clear emphasis is placed on the role of retail promotions for manufacturers, retailers and consumers, which includes the novel distinction of price and volume promotions. The reasoning for using the food category breakfast cereals in Scotland as the setting for the study is set out. Scotland has one of the worst overweight and obesity records within OECD countries both in adults and children linked to unhealthy diets and high promotional purchases. The Scottish Government (2016) reports that 50% of the less healthy products are bought on promotion and these often include ultra-processed food which includes breakfast cereals, making Scotland and this food category a suitable case study to investigate the role of promotions on food consumption.

Chapter 3 presents an overview of the data used in this thesis. It first presents the components of Kantar Worldpanel data including product information, shop information and household information. Attention is drawn to the elaboration of data components and description of the purchases. One area of interest is the effect of promotions across the 'income' distribution and therefore the chapter highlights various measures beyond just income. It explains an additional and broader measure of deprivation – the Scottish Index of Multiple Deprivation, which is the Scottish Government's official tool for identifying geographic areas in Scotland suffering from socio-economic deprivation and combines several different aspects of deprivation into a single index including current income, employment, health, education, geographic access, crime, housing. The Kantar Worldpanel dataset has been merged with the Scottish Index of Multiple Deprivation to enrich the household information with specific neighbourhood characteristics and facilitate a comparison with results from a purely income-based measure. A later section of Chapter 3 provides a review of the possible options available to classify

healthiness of food products. An overview of the nutrient profiling model is given and after critical consideration the study decided to adopt the Food Standards Agency's 2004/05 Nutrient Profiling Model (UK FSA). Finally, the Chapter concludes how the data components have been merged into one dataset and a description of the purchase dataset is provided.

Chapter 4 discusses the role of promotions from a retailer's perspective. The prevalence of retail promotions in the UK is shown by purchases of promoted products in Britain accounting for 40% of all food and drink take home expenditure in 2016 (Smithson et al. 2015). This chapter extends this line of enquiry by investigating the effects of promotion types, principally price and volume promotions, which are both applied differently by retailers and treated differently by consumers. Further, a separate overview on retail promotions applied across health and brand status of breakfast cereal products is provided. From the literature review arises a number of research gaps to be explored. Despite a number of previous attempts exploring the prevalence of retail promotions, studies on this topic are dated, mainly focus on a mix of countries, using different data types, and only few make a connection to the differentiation about promotion types. The econometric models are based on fractional multinomial logit and offer a novel contribution and additional insights to the likelihood what type of products are more likely to be promoted across price and volume promotions.

Chapter 5 examines the influence of retail promotions on consumer purchases, especially across socio-economic groups. Therefore, the Chapter highlights specific socio-economic and demographic factors influencing food choices, such as age, gender, occupation, income and household composition. Aiming to classify the numerous parameters that influence purchases, they were grouped into (i) socio-economic characteristics (ii) product characteristics and (iii) shop characteristics. From this arise a number of research gaps to be explored on consumer focussed literature. As the study focusses in the distribution of household purchases, a later section of Chapter 5 demonstrates the usefulness of quantile regression in comparison to the OLS in food economics by summarising relevant previous studies and highlighting the contribution through examining the full distribution of household consumption.

Chapter 6 provides insights into the power of retail promotions and policies to encourage healthier purchases. The influence of retail promotions on the healthiness of consumer purchases is underlined by recent studies, especially focusing on data in the UK and Scotland. Despite a number of previous attempts exploring the influence of promotions on the healthiness of purchases, studies on this topic are dated, mainly focus on on/off promotion instead of various promotion types, and only few use a comparable method to assess the healthiness. A later section of Chapter 6 demonstrates the how policies try to encourage healthier purchases in the UK, including the restriction of retail promotions but also further options such as reformulations or front-of-pack labelling to educate consumers. The insights gained through a quantile regression analysis on the full distribution of households according to their breakfast cereal purchases by healthiness is important for a policy perspective detecting critical characteristics such as the household size or the level of deprivation, but also product and shop information to the influence on the healthiness across purchase behaviour.

The relevance of the empirical findings in Chapter 4, Chapter 5 and Chapter 6 will be elaborated in the next section. Having summarised the purpose and content of the preceding chapters, the rest of this chapter proceeds as follows. Section 7.2 presents a summary of the key findings. Section 7.3 examines policy implementations and recommendation based on the findings and Section 7.4 respectively considers the value this research contributing to the existing literature. Section 7.5 points out limitations of this study and Section 7.6 suggests potential areas for future research. Section 7.7 concludes with final remarks reaffirming the significance of this research.

7.2. Summary of key findings

In this section I review the main results obtained in Chapter 4, Chapter 5 and Chapter 6, emphasising their relevance to the proposed research objectives.

Research objective 1: Breakfast cereals promoted by retailers

The first research objective is to identify the factors that affect selling breakfast cereal products under promotions from a supply-side orientation with the aim of revealing whether there are differences between price and volume promotions. This research question examines product-level data for 1,122 products sold in 2015 and uses a fractional multinomial logit model to examine the likelihood to promote a product under price and volume promotion. The study assigns a health score to each product using the UK FSA Nutrient profiling model and the results confirm the difference across retail promotion types. Across several product characteristics such as the brand status of a product, the weight of the package and the full price level of a product, contrary effects have been found on the probability of a product to be promoted either under price or volume promotion. The analysis also evaluates whether price and volume promotions are applied different across the health and brand status of products through dividing the dataset into healthy and less healthy breakfast cereal products as well as branded and private-labelled breakfast cereal products. The results suggest that the less healthy a product is, the higher the probability that a product is sold under both promotion types. Across the whole breakfast cereal food category, price promotions are more likely to be used to sell expensive products and private label products whereas volume promotions are more likely to be used for small packaged, unhealthier and branded products.

Thus, promotions play an important role fashioning consumer diets (related to breakfast cereals) as they are applied to less healthy products across both promotion types but are targeted differently. Volume promotions are applied to the less healthy products in the breakfast cereal category as a whole but most markedly among less healthy private label products. Among healthy products, products are more likely to be sold under price promotion as they become less healthy encouraging the consumers to choose unhealthier products across the healthier product range because they are incentivised through a promotional offer. The results further reveal that the brand status affects the

likelihood to promote a product as well and private label products are more likely to be sold under price promotion whereas branded products are more likely to be sold under volume promotion. This finding is consistent with previous studies that have found that less healthy products are more likely to be promoted through retail promotions in general (Coker et al. 2019; Riesenberg et al. 2019a; Bennett et al. 2020).

Research objective 2: Factors impacting breakfast cereal consumption

The second research objective is to identify how household purchases are influenced by retail promotion type and the healthiness of the purchases, but also across specific household characteristics. A quantile regression is applied to investigate the full distribution of consumption behaviour from irregular breakfast cereal eaters up to the very frequent consumers. Household-level data of 2,705 households is analysed and the proportion of purchases made under price and volume promotion is computed. This way of aggregating the data, which is household-level instead of product-level, offers to look through the lens at the consumer – the supply-side orientation as opposed to a demand-side orientation.

The results reveal that retail promotions affect the weekly quantity of breakfast cereals purchased and therefore the consumption across households. Examining price and volume promotions separately, the estimates show that both promotion types encourage consumption. The strongest effect has been found across purchases under volume promotion with significant estimates across the full distribution except for the highest purchasing households. For price promotions, the association was weaker and only significant for the lowest purchasing households, indicating that a price reduction does not automatically lead to purchasing more packages among most household. The interaction model took into consideration the responsiveness of households towards healthy and less healthy promotional purchases, the results highlight that both price and volume promotions on healthy products encourage low purchasing households to buy more (in terms of quantity) implying therefore greater consumption among the irregular breakfast cereal eaters. High consumption households that include breakfast cereals as a staple in their diet are not influenced by promotions on healthy products. Regarding the debate on restricting volume promotions, the results reveal that multi-buys linked to less healthy purchases increase the danger of overconsumption and therefore impact obesity rates and play a key role across families and households with children when trying to tackle childhood obesity. The findings agree with the literature that high promotional shoppers tend to purchase more quantity of unhealthy foods and beverages with up to 11 additional items per month (Smithson et al. 2015; Coker et al. 2019).

Research objective 3: Retail promotion types and their influence on the healthiness of breakfast cereal purchases

The third research objective is to investigate the role of retail promotion types on the healthiness of breakfast cereal purchases and further to examine what type of policies might be successful in

encouraging healthier purchases in the retail environment. A quantile regression approach was used to examine the full distribution across households from the healthiest to the least healthy households.

The estimated results reveal that both price and volume promotions decrease the healthiness of breakfast cereal purchases, which is supported by the current literature (Nakamura et al. 2015; Coker et al. 2019; Campbell et al. 2020). The least healthy households respond to both types of promotion, and strategies for encouraging healthiness of those households should focus on specific groups that already eat unhealthily and are encouraged to eat even unhealthier through the attraction to retail promotions. Price promotions have a similar effect across the healthiest to the least healthy households affecting the full range of households and encouraging them to eat less healthy. For volume promotional purchasers, the healthiest and least healthy households are encouraged to buy predominantly less healthy products. The findings show that the least healthy households are buying less healthy products with a multi-buy, which increases the danger of overconsumption and obesity in the long term. Combined with finding from Chapter 4, promotions are more applied on less healthy products and as households purchase more under promotion, they purchase more unhealthy products.

The results further show other factors that lead to less healthy households: the household size including the number of adults and children living in a household indicating that the bigger the family the greater the index of unhealthy breakfast cereal purchases. Moreover, the more branded products purchased, the less healthy is a household. Additionally, the results reveal that an increase in discounter purchases leads to less healthier breakfast cereal consumption among all households.

Research objective 4: Policy implications to encourage healthier purchases

The last research objective is to derive policy implications from the results across both analyses and to identify practical strategies to enable healthier food shopping which will help improve consumer diets in the long term. Results clearly show the potential for promotions in a pro-health strategy. The detailed analysis highlights that high promotional purchasing households under price and volume promotion influences the healthiness of households negatively – especially focussing on the least healthy household. Further, the findings show the same impact on the healthiest households decreasing the healthiness even stronger. Overall, the results show that policies need to target and protect the least healthy households as they tend to make less healthy purchases with a promotion – irrespectively of the retail promotion type across price or volume promotion. As the least healthy households are the most responsive to promotions, one policy approach might be to restrict retail promotions on less healthy products and at the same time encourage price reductions and multi-buy offers on healthy products only.

Using the findings to improve the food environment, promotions could encourage the purchases of more healthy breakfast cereals and therefore increase the healthiness of households. Price promotions could be a tool to experiment with new healthy products whereas volume promotions applied to healthy products that are familiar and liked can offer households the opportunity to save money through a deep discount. Aiming to improve the poorest and unhealthiest household's diets the most, a combination of

promotional purchases with greater monetary saving, applied to healthy breakfast cereal products might be one solution to tackle the obesity and childhood obesity crisis.

The recently proposed legislation in the UK and Scotland to reduce the influence of retail promotions on unhealthy food and beverage purchases is an attempt to improve the diet and therefore tackle the obesity problem. The findings of the thesis support these government plans as it has been found that retail promotions not just encourage consumption of less healthy breakfast cereals but also decrease the healthiness of the households purchasing them. The evidence confirms the potential efficacy of implementing such policies. The policy measures in national policy agendas include (i) a restriction on the use multi-buy price promotions unhealthy food and beverages, (ii) restricting the advertising of price promotions i.e., in media and in-store, (iii) restricting the placement of unhealthy foods and beverages in prominent locations i.e., checkout and end-of-aisle, (iv) restricting the sale of unlimited refills of unhealthy foods and beverages (Backholer et al. 2019; Bennett et al. 2020).

7.3. Policy implications and recommendations

The abovementioned findings have both academic and societal impacts. Key conclusions that are relevant for policymaking purposes are highlighted as below.

The rising level of obesity in children is one of society's most significant problems. Tackling obesity is increasingly understood as it requires the involvement of a wider number of policy domains other than health alone, because there are many influences on body weight, including the food environment where people purchase their food. Evidence shows that retail promotions increase food consumption and also increase unhealthy eating within households. However, differentiating strategies and encouraging healthier diets is possible through specific targeting of household, product characteristics and a combination of promotion types and healthiness. The empirical results of this thesis support UK government plans as part of the Obesity Plan for Action and HFSS consultation paper (2020) of banning volume promotions on less healthy foods.

Retailers are more likely to promote less healthy products

Across the whole breakfast cereal food category, price promotions are more likely to be used to sell expensive products and private label products whereas volume promotions are more likely to be used for small packaged, less healthier and branded products. In line with previous research (Coker et al. 2019; Riesenberg et al. 2019a; Bennett et al. 2020), the results presented in Chapter 4 confirm that the retailers promote less healthy breakfast cereal products. The differentiation across promotion types allows the results to reveal that volume promotions are found to be applied more on less healthier products. This finding in Chapter 4 suggest that not only are consumers offered less healthy products under promotion, but they also receive more packages of less healthy products through a multi-buy.

The issue of stockpiling through volume promotions is linked to the increased consumption or even an immediate overconsumption instead of purchasing products at a cheaper price and consuming it later when needed. It underlines the UK and Scottish government plans to restrict volume promotions on less healthy products as the results confirm that retailers make use of this strategy to target consumers and increase their sales.

Purchases in less healthy households are influenced by retail promotions

The findings of the thesis not only suggest that promotions increase the consumption of breakfast cereals, but they also decrease the healthiness of the purchases. This empirical evidence echoes the findings of previous research (Smithson et al. 2015; Coker et al. 2019) regarding an increase in purchases influenced by both price and volume promotion and therefore both promotion types have the power to encourage consumption. The strongest effect has been found across purchases under volume promotion, as Chapter 5 reveals. Linking these findings to Chapter 6, gives powerful insights to the healthiness of the consumption and hence the average household's healthiness. Although there is increasing scientific consensus over the role of retail promotions on the healthiness of purchases, this research demonstrated that research needs to distinguish between promotion types and across specific household characteristics. The message is clear:

Price and volume promotions decrease the healthiness and this effect is strongest of the healthiest households. Also, the least healthy households respond to both promotion types, and strategies for encouraging healthiness of those households should focus on specific groups that already eat unhealthily and are encouraged to eat even unhealthier with retail promotions. Again, volume promotions play a crucial role as they do not only increase the consumption but also have the potential to cause overconsumption because the promotional offer is linked to an increase in the quantity, and this could lead to faster consumption after stockpiling. Further, results show that it is an important policy implication as governments try to fight childhood obesity knowing that families with more children eat unhealthier breakfast cereals.

Policies are needed to restrict promotions on less healthy products

Since consumer behaviour linked to food choices is complex and are driven by numerous determinants such as food marketing, strategies of retailers and personal preferences, policy interventions should focus on factors that are found to affect food purchases positively and encourage healthier food choices. For example, the findings offered in Chapter 6 suggest that the least healthy households are responsive to both price and volume promotions and therefore a policy approach might be to restrict retail promotions on less healthy products and at the same time encourage price reductions and multi-buy offers on healthy products only. Using the findings to improve the food environment, retail promotions

could be used to encourage the purchase of more healthy breakfast cereals and therefore to increase the healthiness of households. Price promotions could be a tool to experiment with new healthy products and volume promotions applied to healthy products that are familiar and liked and can therefore offer households the opportunity to save money through a deep discount. Therefore, when aiming to improve the poorest and unhealthiest household's diets most and combining it with their promotional purchases because of the monetary saving, one solution to tackle the obesity and childhood obesity crisis might be to apply promotions to healthy products.

Further implications might be to broaden the policy spectrum to further limit the advertising of retail promotions on less healthy products and to control the placement of unhealthy foods and beverages in prominent locations within a supermarket. Nevertheless, the Scottish Government changed their plans in 2021 about restricting retail promotions due to the COVID-19 pandemic and pressure from the industry side and decided to postpone the final decision on the proposal of the ban of promotions.

More detailed analysis offers valuable insights

Undoubtedly, this research contributes to the current literature on the need to take into account the full distribution of healthiness as well as consumption across all household. The findings of Chapter 5 and Chapter 6 demonstrate that the relevance of the quantile regression model cannot be overlooked especially when policies try to target the least healthy household. The most common way in the food economics literature is to analyse through OLS which offers insights on the average consumer, however when trying to impact the households across their full spectrum a more detailed analysis is needed. Therefore, an important policy implication is the need to extend the research methods in order for policy makers to gain information for instance on the highest consuming households and the least healthy households. Therefore, quantile regression was used to examine low and high levels of consumption and the full span of household's healthiness to inform policy. The insights given from applying a quantile regression model is a great contribution beyond just an OLS model because it offers a detailed analysis across the full distribution of the data. This suggests that conclusions from standard models that assume uniform response across different quantiles of the breakfast cereal purchase distribution may be misleading. Applying this method in the thesis offers deep insights on one crucial ultra-processed food category, which allows to examine the full consumption and healthiness of households, which is particularly important for families with children.

7.4. Contribution to knowledge

Overall, this research contributes to the literatures across food economics, food marketing, and econometrics in several ways. It addresses an important issue within food economics and food

marketing literature. This study investigates retail purchases made under different promotion types through the lens of the retailer and also from the consumer's point of view.

(1) To begin with, this study broadens the current knowledge of the food economics literature by offering evidence of retail promotion types. It is clear from academic evidence that food marketing and retail promotions are extensive, deep, and effective at influencing consumer's preferences and purchases. Retail promotions are a significant feature of food purchasing and are used to encourage consumers to make specific buying choices. Nevertheless, the primary contribution of this study to the food economics literature and the main novelty is that the study investigates retail promotion types and their influence on sales and purchases with scanner data. The study looks at the role of price and volume promotions across retailer, consumer and the government perspective. Based on the type of analysis examining the retailer's perspective through products sold and the household's perspective through products purchased is a novel contribution to the current literature. This extends the scope of previous studies examining either the demand side (Pechey et al. 2013; Taillie et al. 2017) or the supply side (Bogomolova et al. 2015; Nakamura et al. 2015; Powell et al. 2016).

(2) In addition, this study uses the UK FSA nutrient profiling score to assess the healthiness of each product in the dataset. This is especially stressed in Chapter 4 because the health score is not only included as a product characteristic but also the full dataset has been analysed separately based on the definition of the UK FSA score on healthy and less healthy products. To the best of the author's knowledge, no empirical studies looked at the influence of price and volume promotions and combined it with the degree of healthiness across the crucial breakfast cereal category on product-level instead of an overall average score.

(3) The previous econometric modelling literature contains gaps because the majority of studies examines only price discounts instead of multi-item promotions such as volume promotions. As the findings of the thesis have demonstrated, promotions impact differently across both price and volume promotion and have distinguished implications for the supply and the demand side. Moreover, there is the need for research on the effect of supermarket promotions on the consumption of nutrient-poor foods relative to the absence of promotion. This study addresses both and includes the volume promotion in the analysis but also compares the retail promotion types relative to no promotions applied (Hawkes 2009). This adds knowledge to the literature as several earlier studies only deal with on/off promotion, mainly due to a lack of detailed data studies and were unable to differentiate between promotion types (Nakamura et al. 2015; Kaur et al. 2020).

(4) Also, the study proffers statistical evidence to support existing literature that emphasises the contribution to the literature from a methodological point through a non-linear analysis on product-level

data and a quantile regression on household-level data. From methodological standpoint, this research contains some novelties in applying uncommon methods to a large Kantar Worldpanel dataset. This thesis presented novel approaches to the analysis of breakfast cereal purchases of the Kantar Worldpanel data. The methods were carefully designed to provide models of good fit to the data, and account for the data variability and unique detail of the scanner data. The utility of the methods was demonstrated by addressing the three research questions: analysing the products that are promoted by retailers, identifying factors that influence the full range of purchases, and analysing the span of healthiness across households influenced by retail promotions. For this purpose, a fractional multinomial logit model and quantile regression approach was used.

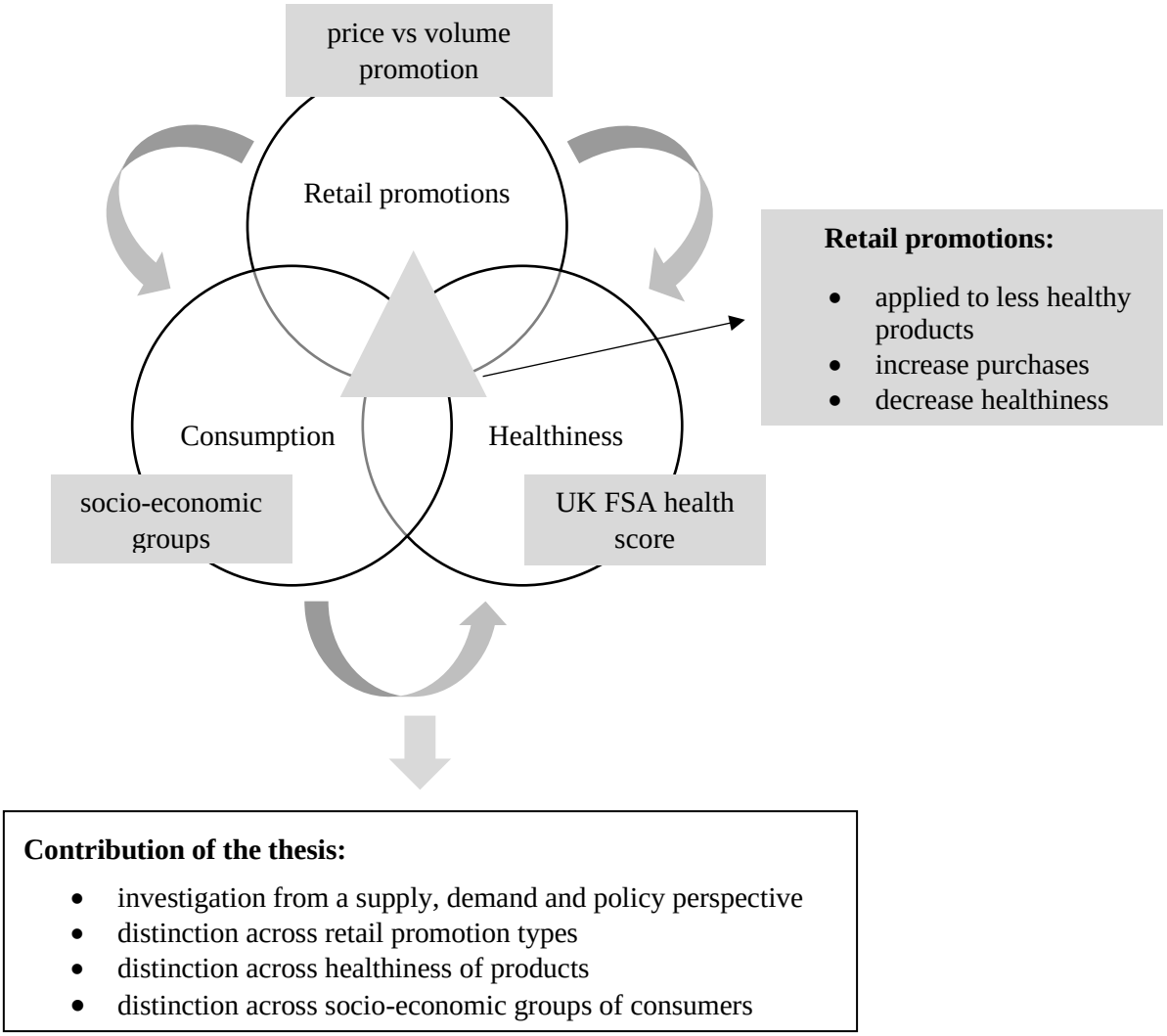
In Chapter 4, the fractional multinomial logit model offers insights to the likelihood that a product is sold under price or volume promotion, whereas the quantile regression model looks at the full distribution of the data – namely, the quantity purchased in Chapter 5 and the full range of healthiness of households in Chapter 6. Again, the prevalent traditional analysis as shown in the majority of the literature would take the average consumption or average healthiness of a household and analyse these using a linear regression model, thus ignoring the full distribution of the data. As the findings show, policy makers need more than the average household but rather the highest consuming households and the least healthy households. Therefore, quantile regression was used to examine low and high levels of consumption and healthiness to inform policy. This includes the tails of the distribution in relation to retail promotions, socio-economic, product and shop characteristics.

Further, linked to the methodology is the role and the scarcity of detailed data. Data is key for the contribution to knowledge as scanner data is expensive and often privately held datasets not available for the public domain. This scarcity of data is addressed in studies, especially calling for details about the differentiation about retail promotion types (Kaur et al. 2020; Placzek 2021). Studies urge to linking datasets with recent information, for instance, supermarket purchases with data on household information, as well as food composition data, to assess the nutritional value of the food consumed in relation to socio-economic determinants. This is what this thesis addresses through combining Kantar Worldpanel data and linking it to the UK FSA score, but also to the Scottish Index of Multiple Deprivation. The future step is to evaluate the effectiveness of policies that try to encourage healthier purchases and healthier food choices, with recent and in-depth data.

(5) Moreover, it contributes to the evidence base linking less healthy dietary patterns and food consumption of ultra-processed foods. This study examines the food category breakfast cereals, a category containing many products across the full health spectrum. Further, this study contributes to the urgent and pressing issue of the role of ultra-processed foods, which includes breakfast cereals. This study intends to clarify whether these purchasing patterns differ by the healthiness of breakfast cereal products, but also across different SES groups. Particularly, the healthiness of each product is assigned with a UK FSA score instead of food category level.

(6) Finally, the study also contributes to throwing light into the bigger policy perspective across OECD countries. This thesis is linked to a novel OECD report of the author, underlining the importance of socio-economic determinants of food choices and policy options to encourage healthier food choices. One option that is clearly stated is to restrict of food marketing. Further, the report adds the wider policy perspective across OECD countries to the thesis, which deals with Scotland, being a part of the UK and OECD countries in terms of high adult and childhood obesity. This bigger picture is needed to achieve an impact on encouraging healthier diets on a global scale. Figure 7.1 shows an integrative model of key contributions of this research.

Figure 7.1 Integrative model of key contributions.



7.5. Limitations of this research

Despite being explained in detail in previous chapters, some limitations merit discussion.

Retail purchases are not necessarily the same as consumption

Scanner data offers the advantage of a detailed range of data, but also it has to be highlighted that purchase data are not equivalent to food intake or consumption but is best described as 'purchases made'. The term 'consumption' in this study should thence be interpreted as purchases made by the households, as an approximation of food consumption as it has been bought to be eaten at home. The Kantar Worldpanel data presented in this thesis relates to purchases only and does not equate to consumption because food waste and preparation or cooking are not accounted for. Therefore, as mentioned throughout the thesis, the results do not provide an overall picture of food purchase in Scotland, due to the fact that the data excludes out-of-home purchasing such as take-away foods and this means this research only represents a part of the diet (Campbell et al. 2020). Moreover, the study only analyses one food category, which is breakfast cereals, and therefore cannot explain the effects on the overall diet.

The prevalence of price promotions is very context specific and therefore makes it difficult to compare results across countries. Therefore, this study focuses on purchases made in Scottish supermarkets and does not consider waste in the households for example losses during cooking or food which will be thrown away, which means that this study analyses purchase data and this is not the same as consumption data because not all foods (breakfast cereals) are being consumed.

Data captures purchased promotions only

Kantar Worldpanel scanner data only includes purchased promotion items and not all the offered promotions by retailer because in order for a product to be captured in the dataset, it must be purchased and scanned by a panel participant and the data is collected from the purchases of a panel. The purchase-based nature of the sample may introduce a bias leading to an overestimation of the prevalence of retail promotions as foods with a promotion are more likely to be purchased than foods that do not carry them (Kaur et al. 2020).

Incomplete picture of additional marketing activities

Another important factor to consider is that the purchased price promotion represents that the promotion has been purchased in the supermarket, but it does not include the combined effect of other influence on the purchase such as the frequency and duration of the promotion, the competition of other retailers

and manufacturers. Other offered marketing promotional activities for example a display promotion within a store or TV advertisement are unknown. Therefore, it does not give an insight to the overall food marketing that the consumer is exposed.

Scanner data characteristics

Scanner data such as the used Kantar Worldpanel data is collected through scanning the barcode of products purchased by participating households of a panel. On the one hand the strength is that it contains a great amount of detail including products and multiple retailers over time. Overall, the estimated prevalence of price promotions is based on the percentage of sales, rather than on the percentage of foods that are available for consumers to purchase. This characteristic of the data is important, since the retail environment is better characterised by food availability data than food sales data. Furthermore, in the analysis the data is collapsed by either product or household level and is therefore aggregated, however it does not allow to include further information that might be useful in the analysis in more detail. Nevertheless, aggregating the data for instance across the year is necessary to account for infrequent purchases within a week so computing annual data was needed to be able to analyse the overall breakfast cereal purchases.

7.6. Areas of future research

The limitations listed in the previous section present many opportunities for extending the scope of this research. Some of the directions for future studies are outlined subsequently.

First, acknowledging the lack of information related to examine a full diet which includes out-of-home and takeaways as well as other categories of food. The effects of retail promotions on the whole food basket purchased instead of one food category (breakfast cereal) should be evaluated in the future. For instance, the quantile regression analysis in Chapter 6 could be replicated to demonstrate how the whole healthiness of a basket of each household is influenced beyond just one food category. Finally, future studies could include actual consumption instead of purchase data only. It focusses on the purchases made in the supermarket and does not consider waste in the households for example losses during cooking or food which will be thrown away.

Second, future studies may examine the retail promotions and their computation differently. A challenge is the fact that promotions are not static and that they change weekly across various retailers, but also across the depth of the discount and the products that they are applied to, therefore a way of aggregation is needed across the year. This study includes the role of promotions as proportion of purchases made under each promotion type as an indication of the purchased promotion types. However, a more refined way to measure retail promotions should be included in future research linking

the promotion directly to a product and the healthiness of the household. Nevertheless, the computation of the large dataset and aggregating it by either product or household level creates a challenge.

Third, future studies could include a more complete picture of the food marketing that consumers are exposed to. In this study, retail promotions represent only promotions that have been purchased in the supermarket, but it does not include the combined effect of other influences on the purchase such as the frequency and duration of the promotion, other marketing activities or the competition of other retailers and manufacturers.

Based on the limitations of this thesis, another possible direction for future research has been identified. Further studies could deal with the effectiveness of policies. The next step is to evaluate the effectiveness of policies that try to encourage healthier purchases and healthier food choices, with recent and in-depth data. More studies should include several layers of information which contains the food environment, socio-economic characteristics of the household, as well as information on food products such as the composition and nutritional information of the products.

7.7. Final remarks

To conclude, the author would like to re-emphasise the significance of this study. All consumers, especially children are uniquely vulnerable to the techniques of food marketing and what type of products are promoted to them is underlined by the significantly increasing advertising budgets for less healthy food products aimed at children. Tackling the obesity crisis among adults and children might require efforts from both the supply and demand sides but also governments to work together on the role of retail promotions to improve the healthiness of food purchases in the retail environment.

Motivated by the fact that consumers are influenced by food marketing on less healthy products, which is a common cause of unhealthy diets and might contribute to a wide variety of diseases and obesity, this study examines marketing and retail promotions in-store and their influence on preferences and purchases. They are employed to encourage shoppers to make certain buying choices, however the majority encourages less healthy choices. Therefore, this research aims to explore the ways to make a change for the consumers and support policy makers with evidence to guide them to stricter measures to protect their population. The empirical results that less healthy products are promoted more and increase consumption and even worse, decrease the healthiness of consumer purchases, is a call for action to use the power of promotions for healthy products only and therefore to still give consumers and retailers the benefits of promotional purchases but use it for good.

Glossary of Terms

Key terms	Explanation
Body Mass Index	The Body Mass Index (BMI) is a ratio of weight-for-height commonly used to classify underweight, normal weight, overweight and obesity in adults. It is a measure of body fat based on weight in relation to height, and applies to most adult men and women aged 20 and over.
Elasticity	Elasticity is a measure of a variable's sensitivity to a change in another variable. In business and economics, elasticity refers the degree to which individuals, consumers or producers change their demand or the amount supplied in response to price or income changes.
Food Standards Agency	The Food Standards Agency (FSA) is responsible for food safety and food hygiene across the UK. The FSA also has responsibility for labelling policy in Scotland, Wales and Northern Ireland, and for nutrition policy in Scotland and Northern Ireland.
Front of pack nutrition labelling	The Front of Pack nutrition labelling scheme combines colour coding and percentage reference intakes in line with UK health ministers' recommendations and the requirements of Article 35 of EU Regulation 1169/2011 on the provision of food information to consumers.
IRI	Information Resources, Inc. (IRI) is an American market research company which provides clients with consumer, shopper, and retail market intelligence and analysis focused on the consumer-packaged goods industry.
Kantar Worldpanel	Kantar Worldpanel is a research company for consumer knowledge and insights based on continuous consumer panels.
Kilojoules	Kilojoules (kJ) showing how much energy a product includes depending on the amount of carbohydrate, protein and fat the food contains (1 kcal = 4.2 kilojoules).
Multi-buy	Discount conditioned on number of items purchased. An example is Buy-One-Get-One-Free (BOGOF).
Nutrient profiling	Nutrient profiling is the science of classifying or ranking foods according to their nutritional composition for reasons related to preventing disease and promoting health.
UK FSA Nutrient profiling model	The UK FSA nutrient profiling (NP) model was developed by the Food Standards Agency (FSA) in 2004-2005 as a tool to help Ofcom differentiate foods and improve the balance of television advertising to children.
Obesity	A state of excessive accumulation of fats, measured by a Body Mass Index greater than or equal to 30 kg/m2.
Organisation for Economic Co-operation and Development	Organisation for Economic Co-operation and Development (OECD) is an intergovernmental economic organisation with 35 member countries, founded in 1960 to stimulate economic progress and world trade.
Retail promotions	In-store sales promotion is any initiative undertaken by a retailer to promote an increase in sales, usage or trial of a product or service. Different types include Temporary price reduction, Y for £X, Multi-buy, Price-marked packs (PMP)
Price promotion	Are considered temporary price reduction offering a monetary reduction on the regular price e.g. 15 % of the regular price.
Volume promotion	Includes Multi-buy offers and Y for x £. They are discounts conditioned on the number of items purchased. An example is Buy-One-Get-One-Free (BOGOF) or 2 for 3£.

Scientific Advisory Committee on Nutrition	Scientific Advisory Committee on Nutrition advises on nutrition and related health matters. It advises Public Health England and other UK government organisations.
Serving size	A serving size is the amount of a food or drink that is generally served. Serving size is a significant consideration in nutrition and weight control. It is a regulated amount of each food that is supposed to be eaten by consumers to maintain a healthy weight.
Scottish Index for Multiple Deprivation	Scottish Government's official tool for identifying those places in Scotland suffering from deprivation. The Scottish Index for Multiple Deprivation (SIMD) identifies the level of multiple deprivation in small areas across all of Scotland in a consistent way. These areas can then be grouped into quintiles. Quintile 1 refers to the most deprived area, and quintile 5 refers to the least deprived area. It incorporates several different aspects of deprivation, combining them into a single index. There are seven domains which are income, employment, health, education, skills and training, housing, geographical access and crime.
Socio-economic groups	Market Research agencies often divide the population into different groupings, based on the occupation of the head of the household, for the purpose of drawing comparisons across a wide range of people - it is used to see how people in differing socio-economic situations react to the same stimuli.
Socio-economic status	An individual's or group's position within a hierarchical social structure. Socioeconomic status depends for example on a combination of variables, including occupation, education, income, wealth, and place of residence.
Sugar-sweetened beverages	A drink, carbonated or uncarbonated, to which corn syrup, glucose, or other sweetening agents have been added.
Take home food and drink	All food and drink purchased for the use within the home for instance retail promotions. It excludes takeaway (including home-delivered takeaway food) and any foods that were purchased for immediate consumption outside the home.
Traffic light	Traffic light labels use green, amber and red signals to show consumers whether a product is high, medium or low in fat, saturated fat, salt, sugar and, ideally, energy (in calories).
Ultra-processed foods	Formulations of ingredients that result from a series of industrial processes (Monteiro *et al.* 2019a).
Value-Added-Tax	A value-added tax (VAT) is a type of consumption tax that is placed on a product whenever value is added at a stage of production and at the point of retail sale. The standard rate of VAT increased to 20% on 4 January 2011 (from 17.5%). (www.gov.uk)
World Health Organisation	The World Health Organisation is a specialized agency of the United Nations that is concerned with international public health. It was established on 22 July 1946 headquartered in Geneva, Switzerland.
WXYfm nutrient profiling model	WXYfm is a scoring system that rates individual foods on a scale from −15 (most healthy) to +40 (least healthy) based on their content of energy, saturated fat, total sugars, sodium, fruit and vegetables, fibre and protein and was invented by the FSA in the UK.
Y for x £	An offer of buying a number of products for a set price such as buying 3 products for 1 pound

Annex

Appendix A

Table A1: fmlogit estimates across datasets

	all	healthy	less_healthy	branded	private
	b/se	b/se	b/se	b/se	b/se
eta_Dpromo_Price					
fullprice_pack(lg)	0.392**	0.364*	0.591*	0.438**	0.439
	(0.132)	(0.147)	(0.277)	(0.161)	(0.277)
weight_pack(lg)	0.072	0.125	0.126	0.146	0.167
	(0.109)	(0.118)	(0.266)	(0.120)	(0.226)
discount_in_%	0.174***	0.173***	0.165***	0.141***	0.239***
	(0.007)	(0.008)	(0.013)	(0.006)	(0.020)
UK_FSA	-0.015	0.045*	-0.072	-0.159	0.130
	(0.110)	(0.022)	(0.041)	(0.136)	(0.143)
branded_product	-0.358**	-0.274	-0.638**		
	(0.127)	(0.147)	(0.241)		
age	-0.020*	-0.015	-0.049**	-0.000	-0.045*
	(0.010)	(0.011)	(0.019)	(0.010)	(0.018)
number_children	-0.199	-0.302*	0.174	-0.069	-0.356
	(0.123)	(0.152)	(0.192)	(0.144)	(0.196)
female	0.106	0.270	-0.593	0.691*	-0.286
	(0.276)	(0.333)	(0.475)	(0.297)	(0.397)
most_deprived_SIMD	0.042	0.144	-0.181	-0.284	0.705
	(0.330)	(0.396)	(0.522)	(0.384)	(0.507)
avg_annual_income	-0.003	-0.008	0.020	-0.007	-0.000
	(0.006)	(0.007)	(0.011)	(0.007)	(0.009)
inter_income*UK_FSA	0.004**			0.002	0.004
	(0.001)			(0.002)	(0.003)
inter_age*UK_FSA	-0.002			0.002	-0.004
	(0.002)			(0.002)	(0.003)
rural_urban	0.064	0.105	-0.709	-0.283	0.546
	(0.275)	(0.310)	(0.627)	(0.279)	(0.452)
shop_mainsupermarket	1.274***	1.190**	2.316*	0.902*	4.106***
	(0.384)	(0.424)	(0.912)	(0.360)	(1.009)
shop_convenience	1.278**	1.164*	2.685**	0.757	4.442***
	(0.481)	(0.524)	(1.001)	(0.497)	(1.133)
shop_discounter	1.039**	0.723	2.510**	-0.744	4.430***
	(0.400)	(0.453)	(0.839)	(0.420)	(0.970)
constant	-3.086***	-3.097***	-2.562*	-3.689***	-5.102***
	(0.741)	(0.871)	(1.296)	(0.745)	(1.468)
eta_Dpromo_Volume					
fullprice_pack(lg)	0.214	0.373	-1.037*	0.544**	-0.654
	(0.195)	(0.235)	(0.484)	(0.200)	(0.514)
weight_pack(lg)	-0.689***	-0.733***	-0.161	-0.849***	0.000
	(0.143)	(0.161)	(0.396)	(0.140)	(0.358)
discount_in_%	0.132***	0.134***	0.118***	0.105***	0.215***
	(0.009)	(0.011)	(0.015)	(0.009)	(0.024)
UK_FSA	0.473***	0.023	0.179*	0.222	0.576**
	(0.119)	(0.037)	(0.077)	(0.128)	(0.216)
branded_product	0.425*	0.615*	0.026		
	(0.205)	(0.268)	(0.391)		
age	-0.027*	-0.018	-0.037	-0.010	-0.093***
	(0.011)	(0.012)	(0.024)	(0.012)	(0.028)
number_children	-0.097	-0.157	0.330	-0.606***	0.449
	(0.169)	(0.193)	(0.328)	(0.180)	(0.259)
female	-0.322	-0.437	-0.026	-0.272	-0.639
	(0.325)	(0.376)	(0.737)	(0.341)	(0.723)
most_deprived_SIMD	0.403	0.209	0.933	0.248	1.422*
	(0.327)	(0.378)	(0.635)	(0.380)	(0.684)
avg_annual_income	-0.003	-0.003	-0.020	-0.003	0.011
	(0.007)	(0.008)	(0.021)	(0.008)	(0.016)
inter_income*UK_FSA	-0.003			-0.001	-0.008
	(0.002)			(0.002)	(0.004)
inter_age*UK_FSA	-0.008***			-0.005*	-0.007
	(0.002)			(0.002)	(0.005)
rural_urban	-0.447	-0.634	0.830	-0.927	0.648
	(0.369)	(0.428)	(0.575)	(0.473)	(0.606)
shop_mainsupermarket	-0.120	-0.377	0.853	0.502	-2.292***
	(0.339)	(0.374)	(0.687)	(0.463)	(0.683)
shop_convenience	0.018	-0.273	1.407	0.421	-1.153
	(0.493)	(0.544)	(1.037)	(0.623)	(1.140)
shop_discounter	-0.864	-0.869	-1.096	-0.115	-3.746**
	(0.498)	(0.571)	(0.972)	(0.548)	(1.234)
constant	-2.925***	-3.165**	-3.372*	-3.515***	0.700
	(0.864)	(1.093)	(1.426)	(0.926)	(2.138)
No. of products	1124	915	209	597	527

* p<0.05, ** p<0.01, *** p<0.001

Appendix B

Table B1: OLS and QR of the interaction model (model 2)

	OLS	Quantile Regression				
		Q10	**Q25**	**Q50**	**Q75**	**Q90**
	Mean purchases	Lowest purchases	Low purchases	Median purchases	High purchases	Highest purchases
Female principal shopper	-0.0015 (0.03036)	0.03332 (0.03041)	0.00112 (0.03332)	-0.01341 (0.03613)	0.01832 (0.04372)	0.01132 (0.03862)
Age of principal shopper	-0.00253** (0.00105)	-0.00201** (0.00102)	-0.00364*** (0.00106)	-0.00167* (0.00091)	0.00051 (0.00105)	-0.00017 (0.00195)
Number of adults	0.05876*** (0.01658)	0.04145* (0.02189)	0.05137** (0.02604)	0.06269*** (0.01985)	0.10893*** (0.02664)	0.10548** (0.04159)
Number of children	0.07557*** (0.01673)	0.02549 (0.02226)	0.04114** (0.02002)	0.06187*** (0.01861)	0.10108*** (0.0202)	0.10008*** (0.0281)
SIMD 1	-0.00775 (0.04411)	0.01718 (0.04911)	-0.08741 (0.0543)	-0.03329 (0.05148)	0.01141 (0.06466)	-0.05239 (0.09298)
SIMD 2	-0.0381 (0.04254)	-0.02002 (0.04924)	-0.09796*** (0.03183)	-0.08316** (0.03329)	-0.00132 (0.05004)	0.00574 (0.06432)
SIMD 3	-0.05915 (0.04371)	-0.03322 (0.05289)	-0.12919*** (0.03511)	-0.09955** (0.04993)	-0.06222 (0.04826)	-0.02181 (0.07275)
SIMD 4	0.01185 (0.04422)	0.02982 (0.05244)	-0.04683 (0.03936)	-0.0062 (0.0519)	-0.00854 (0.05634)	0.01806 (0.0864)
Rural accessibility	0.06845** (0.03363)	0.03773 (0.0362)	0.04826 (0.03464)	0.04208 (0.04444)	0.1239** (0.06055)	0.11153** (0.05219)
Prop. Promo Price (w)	-0.06694 (0.06826)	0.00997 (0.08442)	-0.11314* (0.05823)	-0.15643** (0.07428)	-0.09466 (0.09599)	-0.0912 (0.12322)
Prop. Promo Volume (w)	0.18288 (0.11996)	0.15341 (0.13002)	0.12163 (0.12913)	0.17835 (0.1381)	0.50403*** (0.1536)	.57596** (0.28108)
Prop. Healthy (w)	-0.4773*** (0.08772)	-0.37638*** (0.09988)	-0.66894*** (0.12078)	-0.53049*** (0.16613)	-0.28788* (0.16151)	0.06504 (0.29938)
Interaction price promo*healthy purchases	**0.1429 (0.14074)**	**0.1463 (0.12747)**	**0.30364** (0.13456)**	**0.53971 (0.34422)**	**0.27899 (0.36621)**	**-0.12656 (0.40748)**
Interaction volume promo*healthy purchases	**0.18344 (0.28836)**	**0.48704** (0.24188)**	**0.4944 (0.40056)**	**0.41069 (0.30244)**	**-0.47777 (0.39775)**	**-0.7784 (1.44118)**
Prop. Branded (w)	0.027 (0.04777)	0.10557* (0.06217)	0.15766*** (0.05617)	-0.00725 (0.07104)	-0.13968** (0.06068)	-0.15371* (0.09293)
Log Weight per pack (w)	-0.27573*** (0.0242)	-0.46909*** (0.02472)	-0.39107*** (0.02535)	-0.29946*** (0.03048)	-0.18658*** (0.02781)	-0.16448*** (0.04497)
Log Full price healthy (100g)	-0.42968*** (0.02015)	-0.54812*** (0.02599)	-0.54369*** (0.02399)	-0.48945*** (0.02849)	-0.36216*** (0.02388)	-0.25889*** (0.04569)
Log Full price less healthy (100g)	-0.01134 (0.01002)	-0.02009* (0.01141)	-0.00375 (0.01351)	-0.01387* (0.00829)	-0.01697 (0.01226)	-0.01111 (0.01533)
Prop. Discounter	-0.21095*** (0.04659)	-0.22861*** (0.05176)	-0.21409*** (0.04653)	-0.34613*** (0.07896)	-0.27698*** (0.07552)	-0.19133* (0.10903)
Constant	-2.86011*** (0.10944)	-4.54981*** (0.11567)	-3.84171*** (0.12506)	-3.10005*** (0.10423)	-2.24411*** (0.14506)	-1.47008*** (0.18571)

Note:
The signs (***), (**) and (*) denote significance at 1%, 5% and 10% level respectively. Robust standard errors are presented in parentheses. All test results are not significant unless indicated otherwise through colouring underlining significant coefficients at one glance.

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