Master's degree thesis

LOG950 Logistics

Analyzing grocery shopping behavior in Norway during COVID-19 pandemic- A case study of Oslo

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Preface

In partial fulfillment of the requirements of MSc students in Logistics at Molde University College, we have completed this thesis research entitled "Analyzing grocery shopping behavior during Covid-19 pandemic – A case study of Oslo".

First of all, we thank God for giving us this opportunity and granting us the capability to complete this paper successfully.

We could not have achieved this success without the guidance of our supervisor Edoardo Marcucci and Valerio Gatta, who was part of this project as a co-supervisor. Thank you both for always being supportive, for the inspiring words and helpful information shared in our weekly meetings during this research process.

We want to express our gratitude to the companies Oda and Godtlevert for their contributions to make this paper possible. We are also very thankful for the support we received from each person who gave us some minutes of their time to answer our surveys. Our profound thanks to the families that happily accepted to participate in the shopping diary.

We cannot finish without thanking our families for supporting us from our home countries Ghana and México, and to all our close friends for your continuous motivation.

It was challenging to complete this thesis during this pandemic era, but we definitely enjoyed working with each other. Thank you, amigo!

Abstract

Covid-19 has impacted society at its core, with the outbreak affecting all segments of the human population and altering human activities and behavior. It was strong motivation to perform this study to investigate the potential demand for e-grocery shopping. E-grocery shopping is becoming a growing trend in a time where information technology leads the way. ICT has enabled the operation of business models that had previously not existed before. Grocery retailers are seeing the need to capitalize on the e-commerce model to be competitive in the future. The trend in Norway shows growth in the e-grocery and more Norwegians using the channel, but not many have performed research in this field. Therefore, it is essential to fill the research gap and contribute to the information on consumer behavior and choice of the channel in grocery shopping in Norway.

The paper's objective is to analyze grocery shopping behavior during Covid-19 and its impact on grocery retail market share. Data from 204 respondents is collected through a stated preference questionnaire adapted from literature and 20 respondents of different household categories through a shopping diary survey and two interviews with e-grocery retailers. The study investigates the attributes of product price, lead time, time window, travel time, service cost, and product range through the stated preference survey. The results show that all the attributes negatively impact utility derived by the consumer except product range and time window. It also showed that the time window did not have a significant impact on consumer utility level.

Additionally, it discusses different sub-group categories based on the econometrics output and compares them based on their willingness to pay. The sub-group comparisons demonstrate the insights that can be used as an opportunity for personalized marketing. The main econometric results illustrate that traditional in-store shopping is still preferred if no market condition is specified.

Based on the results from all the data collected, the study discusses some suggestions for pricing and marketing to increase the market share of the e-grocery channel. This thesis has contributed to academics by providing a database on how the Norwegian customer behaves regarding grocery shopping.

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1. Introduction

1.1 Background for the thesis

E-commerce can be described as selling products or services over the internet across geopolitical borders from a company's country of origin (Investopedia 2020). This differs from the older brick-and-mortar model, where buying and selling goods requires an active and physical interaction between the buyer and the seller. The accelerated growth rate of e-commerce facilitates the trading of goods and services amongst consumers and retailers globally. According to Vasić, Kilibarda, and Kaurin (2019), the explosion of e-commerce can be attributed to the fact that it represents a more economical and convenient approach to shopping than traditional shopping. Initial concerns over shopping online, such as personal information leaks and fraud, are lower today because people have recognized the advantage offered by online shopping (Vasić, Kilibarda, and Kaurin 2019). Figure 1 below reports the trends and statistics data of e-commerce from 2014 to date in 2021. Cumulative data anticipates a 276.9% increase in global e-commerce sales over the currently tracked period (Shopify Inc 2021).

Figure 1.Global eCommerce market size: Retail eCommerce sales worldwide
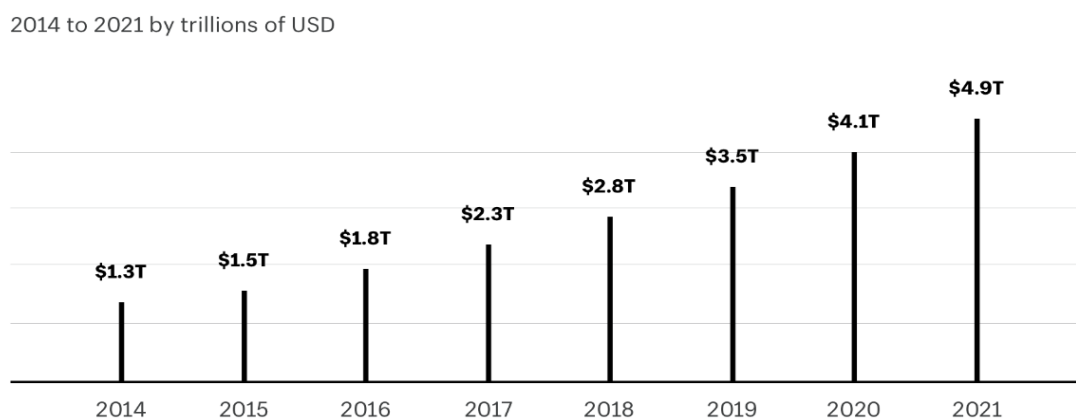
Source: (Shopify Inc 2021)

Global e-commerce sales totaled USD $ 3.5 trillion in 2019, corresponding to about 14% of total retail sales worldwide of USD $ 25 trillion (PostNord 2020). Europe has accounted for 10% of global e-commerce sales, with an estimated USD $349 billion in 2019 (PostNord 2020).

E-commerce activities in the Asia-Pacific region represent over 70% of global e-commerce, with China alone accounting for $740 billion and the United States accounting for $560 billion. Statistics from the European e-commerce market show western Europe accounting for the majority of the growth, with the United Kingdom leading at $93 billion in e-commerce sales. Germany and France follow with $77 billion and $55 billion in e-commerce sales, respectively. The regions with the slowest e-commerce growth rates are Africa and the Middle East. A report generated by Shopify Inc (2021) attributes the growth to low internet adoption and slow adoption of technology by the population.

According to (PostNord 2019) annual and sustainability report, consumers in the Nordic region, specifically Norway, Sweden, Denmark, and Finland, accounted for 112 billion Swedish kroner (SEK), approximately USD $11.6 billion in e-commerce sales in the first half of 2019. Norway accounts for SEK 25.9 billion, giving it a per capita of SEK 6,500 per person, the highest in the Nordic region. E-commerce statistics of the Nordic region from the report (PostNord 2019) show that the leading category of products purchased online was clothing and shoes at 37%. Following are beauty and health and home electronics at 24% and 22%, respectively. Some minor noticeable differences can be seen in the report (PostNord 2019), where Sweden has a higher figure in e-commerce sales of beauty and health products than others in the region. Norway, in comparison, leads in online sporting good purchase due to the physically active nature of Norwegians.

The 2020 e-commerce report released by PostNord (2020) indicates how increasingly mature e-commerce is becoming, evidenced by an average 15% increase in sales compared with the year 2019. The report shows that the proportion of people shopping online have increased modestly by just about a percentage point. A more apparent change shows that previously reluctant consumer groups, such as elderly people, have started to shop online more often, which has been attributed to the coronavirus pandemic.

According to PostNord (2020), the e-commerce industry in Norway was worth 4.9 billion in 2017, of which cross-border transactions represented 16%. About 80% of leading retailers in Norway have an e-commerce app and mobile-optimized website, showing how well-developed e-commerce is in the country. The most visited e-commerce shops in Norway are Komplett, Elkjop, Zalando, and Oda, formerly called Kolonial (Nordea 2021). Komplett leads the Norwegian e-commerce market with net sales of USD $288 million generated in 2019, followed by elkjop.no with USD $199 million, zalando.no with USD $156 million, and kolonial.no with sales of USD $ 124 million in 2019 (Statista 2021c). One of the factors

leading the growth of e-commerce in Norway is the quality of IT and infrastructure, making it easy and quick to deliver orders (Nordea 2021).

Even though the e-grocery industry in Norway was only approximately 5% of the total e-commerce industry in 2016, several analysts expect that the e-grocery business will continue to develop in the future (PostNord 2016). According to (Nielsen 2017), about 11.6% of Norwegians have purchased groceries online, which is double since 2016, clearly showing growth in the sector. The growing trend in e-grocery shopping sparks the interest to investigate the potential demand for Norwegians and the subsequent changes in the market share. The study becomes even more relevant when considering Covid-19 which has affected many aspects of human activities.

The research also takes a look at the implications on transport because grocery shopping is linked to transportation. Humans buy groceries as a necessity, especially during this pandemic, and this activity, whether performed online or offline, would involve a form of traveling. Buying online can mean a retailer traveling a distance to deliver, and offline could indicate the demand side making this journey. The paper attempts to evaluate the implication of channel choices on transportation.

1.2 Research problem & questions

The research problem of this thesis is to investigate grocery shopping behavior during Covid-19. The thesis will investigate if consumers are willing to accept alternative choices besides the status quo in the grocery shopping channel and the utility derived from it. The choice influence on grocery market share and the implications on transportation will also be discussed.

To perform an empirical analysis of the problem mentioned above, this thesis will answer the three research questions listed below.

Question 1. What is the potential demand for e-grocery in Oslo?

On the backdrop of existing literature, this study will investigate if residents living in Oslo are aware of the e-grocery channel, their willingness to use this channel, and the factors that affect this decision. The study will adopt attributes from previous literature and conducts a

focus group discussion to identify key ones and set up the consumer preferences through stated preference choice modeling. In the absence of adequate empirical proof, the study assumes that the stated preference approach may be more beneficial for data collection and analysis. The study would then look at how the main factors affect customer preference by calculating willingness to pay.

Question 2. What are the implications regarding this potential e-grocery demand in Oslo?

The E-grocery channel's growth potential could become an adequate substitute for traditional grocery shopping trips and could eliminate the need for customers to travel to stores for grocery shopping. Since the e-grocery channel transfers last-mile delivery from the consumer to the supermarket, e-grocery demand in Oslo may negatively affect passenger and freight transportation. Challenges like difficulties in implementing home delivery and issues related to CO2 emissions will eventually become more apparent for companies in the industry and policymakers.

Question 3. How has the COVID-19 influenced grocery purchasing and supply?

The COVID-19 pandemic in Norway is part of a global pandemic that began in the first half of 2020 and continues to this day. On February 26th, 2020, the virus arrived in the region (Norwegian Institue of Public Health 2021). The number of cases grew quickly, necessitating the implementation of several safety measures aimed at achieving physical separation, which began on March 12th. Although grocery stores have been allowed to open throughout the various lockdowns in Oslo, there have been many factors influencing business as usual. This paper will investigate this question using interviews on both the demand side and the supply side. Demand-side interviews will try to identify changes in the pattern of behaviors for people with regard to grocery shopping. The supply-side interviews will be acquiring data from grocery distributors or stores to identify how the pandemic has affected operations.

1.3 Scope

The Scope of study in the thesis or research paper explains what information or subject is being analyzed. Throughout this study, Oslo is used homogeneously to represent the Capital city of Norway, but it constitutes both a municipality and a county. According to Statistics Norway (2021), 1,036,059 people live in the greater urban area of Oslo, while 689,242 people live in the municipality of Oslo. This makes Oslo the most populated municipality and city in Norway and has a large share of e-grocery providers situated in and offering products in this region. Some multi-channel grocery providers also have chosen only to provide their e-grocery channel offers to this municipality due to a large number of potential customers. These reasons and limitations in funding make Oslo's compelling case to be the focus scope of this research.

1.4 Structure of the Thesis

The next portion of the paper's structure includes a brief analysis of previous research on the effects of the Internet on grocery retailing, transportation, and consumer channel preferences. This section also includes a literature review of related theories as a basis for determining methodology and investigating the research questions mentioned above. The third section depicts a methodology discussion that demonstrates a framework for using the stated preference method as the primary method for collecting and analyzing data. The fourth section gives a wide and comprehensive picture of the current state of the Norwegian grocery industry. The questionnaire overview and data description sections are the following two sections. The key observations and econometric results are evaluated in chapter six and, in addition, addresses policy implications on transportation as well as managerial implications for E-grocery in the future. Finally, the last section summarizes the key findings by responding to the three research questions and presenting the paper's limitations.

2. Literature Review

2.1 Introduction

The literature review identifies and organizes the concepts in the relevant literature. It will establish familiarity with and understand existing findings in a specific area before carrying out a new investigation. The literature review is used in this paper to explore the information frontier about E-grocery and provide background for the research and explain it.

The information presented will help readers understand the following chapters regarding the online choice experiment conducted in Oslo, Norway, during the Covid-19 pandemic.

ScienceDirect and Emerald insights are the primarily used databases for this literature review to ensure that the articles have a high degree of scientific material. To avoid using the arbitrary method of research, the tentative key terms chosen for the literature review include: "E-commerce", "E-grocery", "City logistics", "Channel choice theory." ScienceDirect searches of the keyword E-commerce produced 72021 results for researched and reviewed articles. While e-grocery shopping showed 8051 results, and channel choice theory had 34 results.

Due to the excessive number of results obtained, a refinement strategy was used to filter out articles that would not be relevant to this study. The scope of the research is limited by the year published, document type (researched and reviewed articles), and research fields (retail and marketing, transport economics, and logistics). Papers published from the year 2000 to 2021 were the only ones used in this study.

Based on the relevance of this study, the literature review will include a thorough investigation of technology's impact on e-commerce, grocery retailing, consumer choices, transportation, and the COVID-19 pandemic impact. In addition, previous research on consumer channel choice will be discussed in this literature review, followed by an assessment of the stated and revealed preference methods. Figure 2.2 depicts the framework of the literature review.

Figure 2. Structure of the literature review
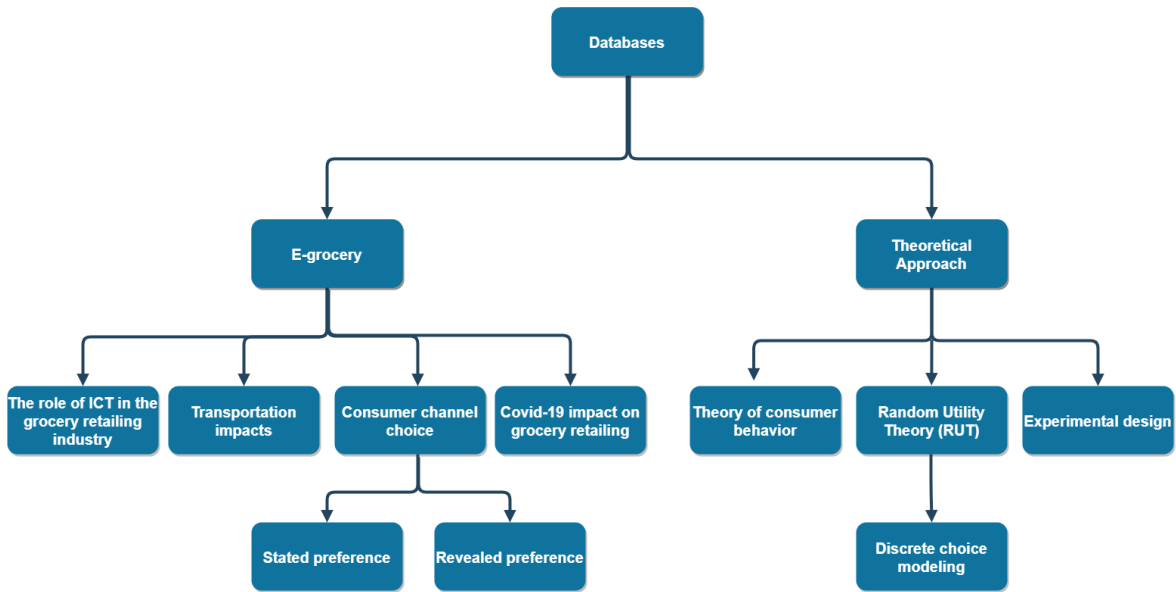
Source: Adapted from previous studies (Chao, Li, and Marcucci 2018).

2.2 E-grocery

2.2.1 E-grocery development

E-grocery (or online grocery) refers to the possibility of buying groceries through an internet platform from any device (Mkansi, Eresia-Eke, and Emmanuel-Ebikake 2018). The UK was the first European country to introduce this new shopping alternative in the grocery market in 2000. And the supermarkets that offered this service were Ocado and Tesco. (Saskia, Mareï, and Blanquart 2016).

The global online grocery market has been gradually growing and became popular among different disciplines due to the simple way of use. It makes consumers' lives easier, allowing them to order groceries from the comfort of their own home or workplaces and have them delivered only a few hours later. In the past, grocery shoppers could only buy the products sold at the nearest brick-and-mortar supermarket. In contrast, buying groceries online is now the preferred method for tens of millions of Americans (Martín, Pagliara, and Román 2019). Home delivery (HD) and click and pick (CP) are the two main alternatives offered in online shopping.

(Nielsen 2018) reported that 30% of the United States population does E-grocery shopping, and within the next ten years, this percentage is projected to rise to 70%. In fact, 24% of Americans buy products online through their mobile devices, especially the millennial consumers, which are considered the largest segment of e-grocery.

Online grocery shopping offers a variety of benefits to both retailers and consumers. From the online retailer's perspective, they get unlimited trading hours, broaden their global scope, improve customer experience, speed up sales, and shorten inventory cycles (Pantano et al. 2016). On the other hand, economic value, a wide range of goods, comfort, time savings, home delivery, connection with various retailers are the main advantages for consumers (Sreeram, Kesharwani, and Desai 2017).

Before the COVID-19 virus outbreak, ordering groceries online was merely a convenient option, but it is considered a necessity nowadays. (Bryk 2021).

2.2.1.1 Shopping behavior in Norway

The consumers in Norway are very interested in new technologies. Norwegians are willing to pay a higher amount to get high-quality products. It means that low prices are less important than the value for money. Most likely, before buying a product online or offline, people will investigate the details of the items. On average, consumers in Norway spend €2,522 a year on online shopping and prefer to shop in international markets to avoid paying high domestic prices. Products from China, United States, Sweden, and Germany constitute 39% of internet purchases made by Norwegians (Statista 2021c).

According to data from Statista, there are more male online shoppers than females. And the tendency for the coming years is to maintain it that way. In a month, consumers buy online around 4 or 4 times. As opposed to shopping in physical shops, more than 20% of Norwegians choose to buy online because it is seen to be more cost-effective. In reality, displaying the overall price and detail simply and straightforwardly is a crucial factor in the performance of online retailers. In Norway, two-thirds of online shoppers tend to pay with a credit card, while one-seventh prefers to pay with PayPal.

Figure 3. Families and households

Families and households		
	2019	2020
Private households	2 439 242	2 475 168
Living alone	948 474	974 168
Couples without children	587 608	597 265
Married couples with children 0-17 years	317 028	312 968
Cohabiting couples with children 0-17 years	172 272	174 719
Mother/father with children 0-17 years	110 578	110 287
One-family households with adult children	182 848	183 627
Two or more-family households without children 0-17 years	88 477	90 741
Two or more-family households with children 0-17 years	31 957	31 393
Persons in private households	5 277 899	5 318 533
Number of persons per private household	2.16	2.15
Population by type of households	5 316 388	5 353 899
Private households	5 277 899	5 318 533
One-family household	4 890 820	4 929 021
Two or more-family households	387 079	389 512
Other households	38 489	35 366

Source: (SSB 2020)

On average, a household consists of 2.15 people where the majority of households are people living alone. The percentage of the household decreases from year to year. Women are 49.6% of the total population. About 83.4% of the population lives in urban areas, while the south has a denser population due to the better climate and connectivity with Europe. The main cities are Oslo, Bergen, and Trondheim (Markets 2021).

Since Norway's reaction to the COVID-19 pandemic was more moderate than that of other European countries, the country avoided the worst economic effects of the pandemic in 2020. As a result, demand levels are not predicted to plummet dramatically, although they would be smaller.

Figure 4. How do Norwegians use shopping centers today?
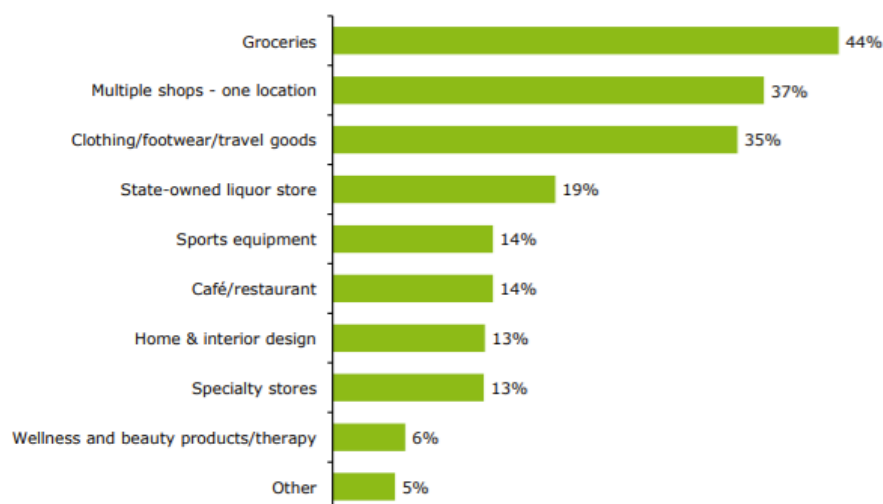
Source: (Deloitte AS 2019)

Norway has the most significant density of shopping malls in Europe, as compared to its population. As seen in figure 4, the main reasons Norwegians visit shopping centers are grocery stores and the large variety of stores found in the same location. There are different sizes of shopping centers in Norway, and Norwegians usually go shopping to the most prominent malls located in the neighboring country of Sweden close to the Norwegian border. According to the report presented by (Deloitte AS 2019) shows that approximately 50% of Norwegians visit shopping centers every week or even more often.

Figure 1. describes consumption expenditure on groceries per household in Norway in 2018 (per county). The county of Sogn og Fjordane registered the highest amount meaning that in a year, families living in that area spend around 38,761 Norwegian Kroner (NOK)(Statista 2019) while Oslo was among the lowest with 27,809 NOK.

Figure 5. Household consumption expenditure on groceries in Norway
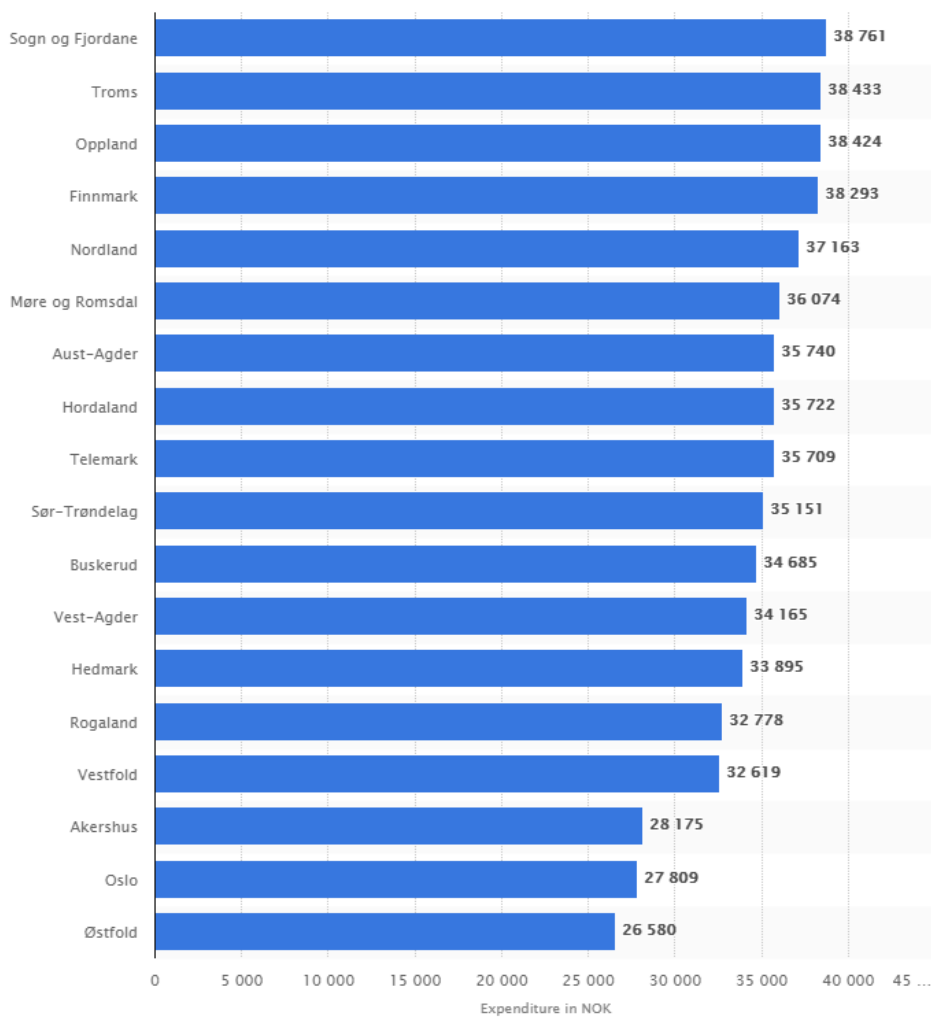
Source: (Statista 2019)

Grocery shopping accounts for a large portion of the Norwegians household spending; however, it becomes less significant if the income increases if we compare it with other products. When referring to groceries, the following categories are included: dairy products & eggs, meat, fish & seafood, vegetables, fruits, bread & cereal products, oil & fats, spreads & sweeteners, sauces & condiments, convenience food, confectionery & snacks, baby food, and pet food. According to (Statista 2021a), the grocery market in Norway is expected to grow annually by 0.87%. The most purchased category of products is Meat with a market volume of US$4,367m in 2021. According to the most recent statistics from the National statistical institute of Norway, online retail will account for 1.6% of consumer spending on groceries, beverages, and tobacco products in 2021.

The following graph was generated by *(Statista 2018) and showed* the individuals who bought groceries online in Norway in 2017 by frequency. 90% of the respondents said they did not buy groceries online over the past 12 months. In contrast, only a small percentage of the sample stated that they had bought groceries online over the last four weeks.

Figure 6. Share of individuals who shopped groceries online in Norway in 2017
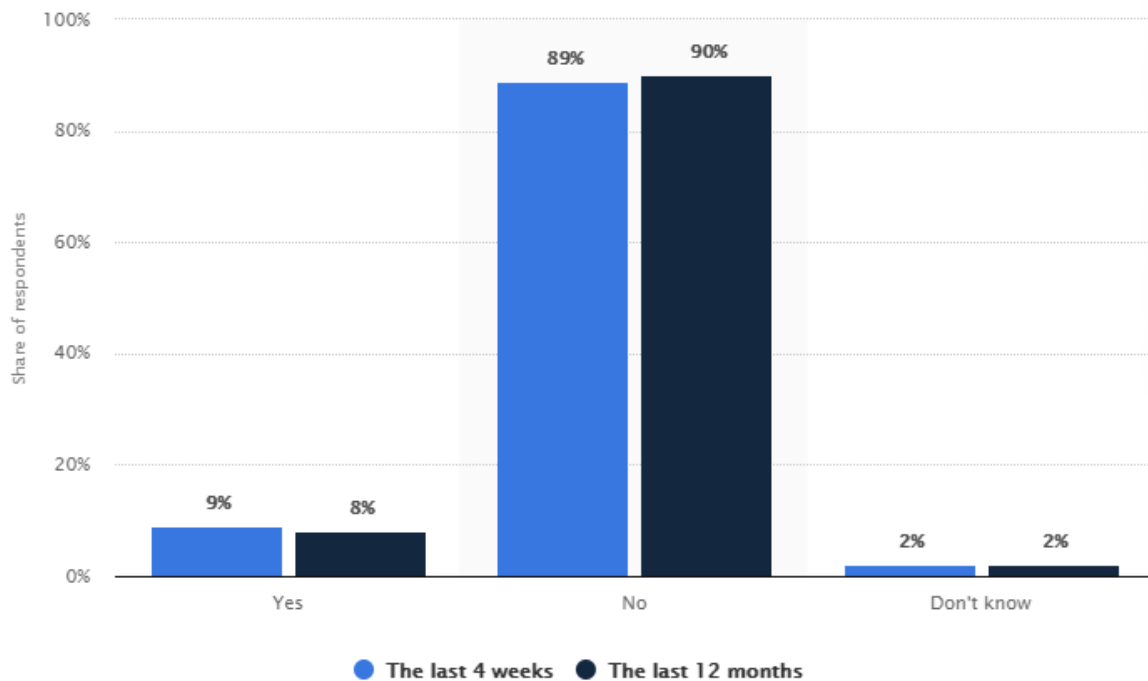
Source: (Statista 2018)

2.3 The role of ICT in the grocery sector

(ITU 2018) stated that ICTs are a critical promoter of economic growth and evolution. Therefore, it is essential to go into more detail about this topic. The present section explores how technological development has impacted consumers' purchasing habits and the grocery retailers considering the current situation.

2.3.1 ICT's impact on consumer's behavior

Consumers' shopping preferences have clearly changed due to new information and communication technologies (ICT) (Marcucci et al. 2021). Mainly, the Internet has contributed considerably to this change creating a new shopping channel that is more efficient than the traditional one. By searching on the Internet, consumers can easily find goods, specifications of the products, and retailers, allowing them to save time and avoid the need to travel (Kacen, Hess, and Chiang 2013).

According to the International Telecommunication Union (ITU 2018), 51.2% of the world's population (3.9 billion people) had access to the Internet in 2018. This network helps people stay in contact with each other and ease communication between companies and their customers.

2.3.1.1 Internet usage in Norway

In 2018, 96% of the households in Norway had access to the Internet, where 95% use it on a daily basis. Besides, Norwegians had approximately eight devices per household, leading the list among the Nordic countries. In contrast, the last place was for Denmark, which registered on average 6.83 devices per household (Statista 2021b).

Oslo/Akershus and Agder/Rogaland had the highest percentage of internet users, with 99% of the population. In contrast, the region with fewer internet users is concentrated in the North of Norway, accounting for only 96%. The following figure shows the share of the population with access to the Internet from 1997 to 2019 in Norway.

Figure 7. Share of the population with access to the Internet
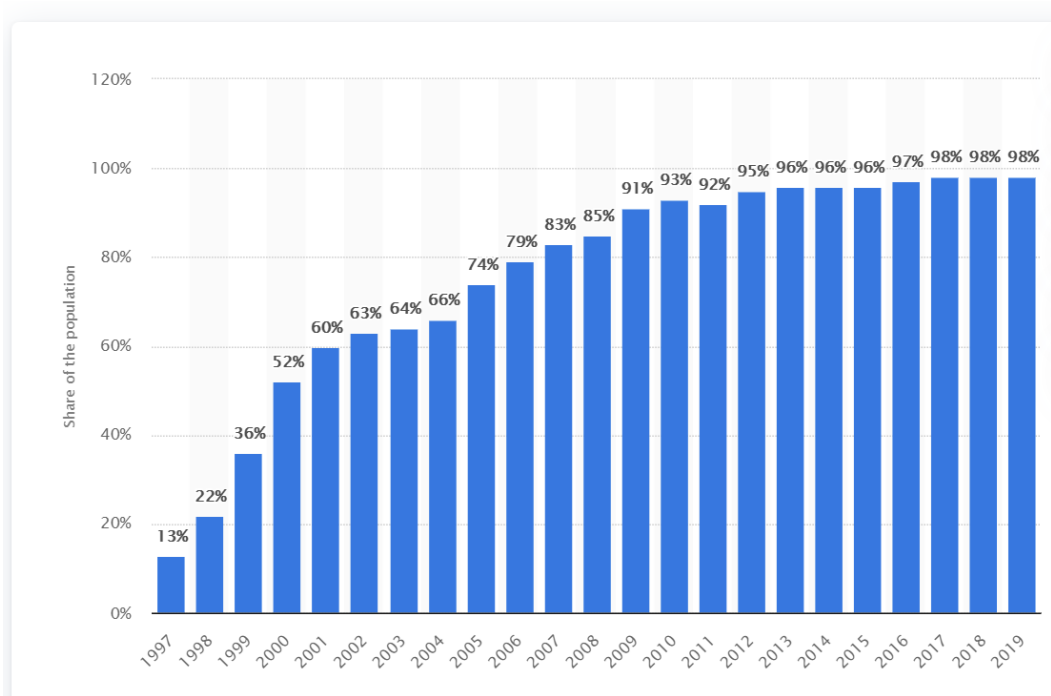
Source: (Statista 2021b)

2.3.2 ICT's impact on grocery retailing

The exponential development of ICT has led to increasing e-commerce and has made a call for a continuous improvement of retailing. Therefore, innovation has become the key to success for retailers operating in a highly competitive market (Pantano et al. 2017).

The Internet, smartphones, and social media have transformed the retail-consumer relationship by integrating different sources of various channels. (Shi et al. 2020). With this in mind, the retail industry suggests a transition from a multichannel to an omnichannel approach by combining information and services. This action will minimize the data mismatch and, at the same time, will improve the overall experience. (Shen et al. 2018) defines omnichannel as "a unified approach that manages channels as intermingled touch points to allow consumers to have a seamless experience within an ecosystem." Following this concept, retailers must integrate their core sources by evaluating consumer's behavior using both online and offline touch-points at the same time.

The retail sector has benefited from the Internet in many ways. For example, it allows retailers to communicate more directly with their customers, it provides a new distribution channel, and at the same time facilitates the flow of information (Saskia, Mareï, and Blanquart 2016).

Besides traditional grocery stores, other players in the grocery supply chain (producers, wholesalers, and service providers) can also have the opportunity to enter the grocery market thanks to the Internet. However, pure Internet retailers and emerging start-ups are now attempting to compete in the grocery market by selling groceries online (Saskia, Mareï, and Blanquart 2016).

The major global online retailers in 2021 are illustrated in figure 1, and according to this information, Amazon.com is currently the E-grocery market leader.

Figure 8. Global online retailers in 2021

Ranking	Retailer	Home country	Business foundations	Total company revenues (billions)
1	Walmart	USA	Mass/Hyper	$519.93
2	Amazon.com	USA	Ecommerce	$280.52
3	Schwarz Group	Germany	Discount Grocery	$133.89
4	Aldi	Germany	Discount Grocery	$116.06
5	Alibaba	China	Ecommerce	$71.99
6	Costco	USA	Club	$163.22
7	Ahold Delhaize	Netherlands	Grocery	$78.17
8	Carrefour	France	Mass/Hyper	$82.60
9	Ikea	Netherlands	Furniture	$45.18
10	JD.com	China	Ecommerce	$82.86

Source: NRF (2021)

Smartphones are usually the most used device to navigate the Internet, especially in developing countries. As a result, online retailers must focus on mobile strategies. Having a responsive design is a key factor to increase retailer's sales. According to (Pantano et al.

2016), 31% of the consumers use their tablets to shop online. The trends mentioned before contribute to reinforce the competitive advantage of omnichannel retailers. Therefore, retails must satisfy consumers' needs by offering reduced prices, premium options, and peace of mind to improve digital engagement. Additionally, retailers must provide an easy-to-navigate website including an extensive range of well-detailed, unique items and many images, as well as trusted security systems.

2.4 Transportation impacts of E-grocery

One of the most significant limitations for the growth of e-commerce in general and the e-grocery business, in particular, is the transport infrastructure. (Punakivi and Saranen 2001). Therefore, we will go into more detail to understand the effects of e-commerce development on individual shopping trips and freight logistics.

Norway registered a global record in 2020, becoming the first country with more sales of electric cars. Approximately, 70% of the sales corresponded to electric cars. (SSB 2021a), reported a total of 464,000 units. See figure 8.

Figure 9. Number of electric cars and plug-in hybrids in Norway from 2012 to 2020
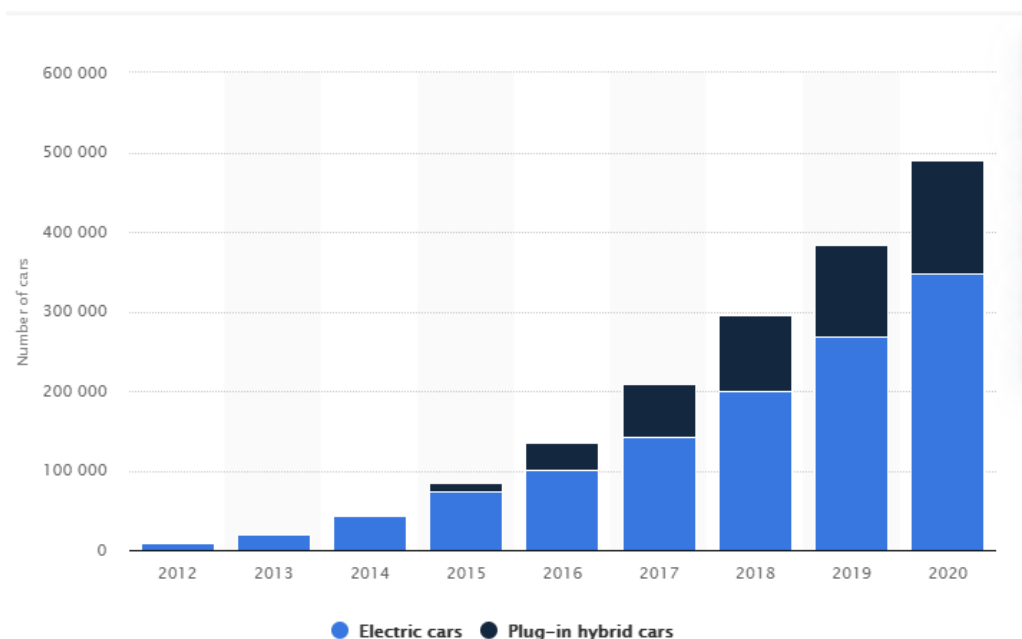
Source: (SSB 2021a)

2.5 Consumer Channel choice

Distribution channels are considered one of the marketing process tools, such as product design, advertising, and merchandising. (Coelho and Easingwood 2005) defines the use of two or more distribution channels to make the product or service available for the target customer as multichannel strategies. The use of multiple channels has rapidly become an option for many products. The pressure to add online presence has made more, and many more retailers and organizations, become multichannel entities (Schoenbachler and Gordon 2002). According to (Reardon and McCorkle 2002), the consumer channel choice alternates between distribution channels based on the relative opportunity costs of time, cost of goods, pleasure derived from shopping, the perceived value of goods, and relative risk of each channel.

Consumer choice is a widely explored area of study where many researchers approach using different methodologies. (AL-Majali and Prigmore 2010) Study the influences that direct consumers to choose online shopping or avoid them when there is an available alternative channel. The research showed factors such as getting better prices, 24/7 access, product varieties, and international purchasing to be a powerful influence on the consumer choice of an online channel. Factors such as privacy & security, social interaction, and delivery delays were a negative influence on consumer choice of online channel.

(Valentini, Montaguti, and Neslin 2011) Study how consumers choose which channels to use and how this decision-making process changes over time whiles considering the dynamic nature of consumers' channel choice decisions. The research of (Chintagunta, Chu, and Cebollada 2012) explores the different transaction costs consumers incur for in-store and online grocery purchases. They find heterogeneity in costs according to the hold and delivery fees discourages online shopping. (Suel and Polak 2017) developed a joint channel shopping destination and travel mode discrete choice model to study the consumers' choice behavior. (Chocarro Eguaras, Cortiñas Ugalde, and Villanueva Orbaiz 2013) argue that time pressure and store distance are determinants of channel choice and affect the probability of online purchase. (Crocco, Eboli, and Mazzulla 2013) also identify socio-economic factors, consumer attitudes, and shopping mode characteristics to have an influence on online shopping. Recent studies (Gatta et al. 2020) investigate consumers' willingness to accept digitalized services connected to grocery shopping using a discrete choice/ agent-based modeling approach. Through a stated preference survey, an initial investigation of consumer preference of e-grocery shopping was performed in Rome where University students were

interviewed as early adopters in this research. The results from the discrete choice modeling showed statistics of the answers regarding consumer's potential acceptability of buying groceries online. Findings from the research give helpful input to characterize the agent's behavior, enabling policymakers to develop policies capable of jointly accommodating consumer preferences. In summary previous research on consumer choice put attention on attributes and consumer behavior with small attention on grocery shopping to a stated preference for hypothetical scenarios and different configurations of shopping strategies. (Gatta et al. 2020) studied this phenomenon by focusing on consumer preference for alternative shopping strategies and understanding the possible transport and environmental impact. The contribution of this paper is to perform sound research and analysis of e-grocery demand in Oslo using the consumer preference for alternative shopping strategies in the post-COVID-19 pandemic era. This study will attempt to discover the transport and environmental changes that can be ascribed to the different market segments of people buying offline or online by use of a shopping diary.

2.5.1 Stated preference methods

Previous studies show that individual consumer behavior can contribute considerably to the design of a product or service in the distribution channel when designing strategies for price or choosing the best plan for communication and in public welfare research (Louviere, Hensher, and Swait 2000). Stated Preference (SP) or Stated Choice (SC) refers to placing decision-makers in designed experiments that present hypothetical choices rather than actual choices in the market. Under this schema, the attributes and their levels are pre-determined without measurement error and varied to establish choice alternatives because a systematic and designed process generates the data.

SP also tries to learn people's willingness to pay by directly asking them how much they value certain environmental goods or services through designed surveys (Seo 2017). SP surveys and experiments are used in numerous research fields such as economics, environmental evaluations, and transport. Respondents in an SP experiment are asked to decide from different options in a choice set according to their preferences in a hypothetical (or virtual) market. (Gatta et al. 2018) explains that SP's goal is to investigate the relative influence of independent variables on a given observed event. However, since SP responses are "stated" rather than "actual", they cannot be 100% reliable because people may choose different alternatives than those they say they will/would.

2.5.2 Revealed preference

As explained by (Ginsburgh and Throsby 2006), "Revealed preferences surveys (RP) are about choices that individuals have actually made." This type of survey is also known as market data and is frequently used by analysts from Economic, marketing, and transport areas to estimate models associated with discrete choice behavior. The information obtained may contain significant amounts of noise resulting from different factors such as measurement error (Louviere, Hensher, and Swait 2000). In cases where direct observation is viable, RP can be calculated with low error (if any). For example, record consumers while doing grocery shopping to see what type of brands they choose or buy.

When direct observation is possible, RP choices can be calculated with relatively little (if any) error. For example, recording the brands chosen by consumers in supermarkets or selected modes by travelers in the act of making trips).

This study has combined both RP and SP data to take advantage of the benefits provided by each method and try to minimize their weaknesses.

2.6 COVID-19 effect on consumer behavior and the grocery retailing

To understand the impact of the coronavirus on the global retail sector, we must begin with a general overview of the pandemic, followed by an investigation of its effect on consumer behavior and retail markets.

2.6.1 The COVID-19 pandemic

On March 11, 2020, the World Health Organization (WHO) declared the novel coronavirus (COVID-19) outbreak a global pandemic. The disease began in Wuhan, Hubei province, China and has spread worldwide (Ghebreyesus 2020). It is defined by the (WHO 2021) as "an infectious disease caused by a newly discovered coronavirus." It produces different symptoms depending on the person, but the most common symptoms are fever, dry cough, and tiredness. Also, more severe cases have developed difficulty breathing, chest pain, and loss of speech or movement.

The emerging virus has severely challenged the health care systems and society due to the high risk of infection. The virus spreads mainly by droplets of saliva or discharges from the nose when infected individual coughs or sneezes; wearing face masks and avoiding crowded places are some of the recommendations.

In an attempt to prevent infection and slow down the transmission of Covid-19, consumers have changed their shopping habits, and retailers had adjusted to it as well. (Grashuis, Skevas, and Segovia 2020).

2.6.2 Impact of COVID-19 on consumer behavior

Since March 2020, everyone's life has changed due to the start of lockdowns and quarantines, forcing us to adjust our habits and lifestyles to protect ourselves from getting infected. (Sheth 2020) describes the eight immediate impacts of COVID-19 on consumer behavior in figure 9.

Figure 10. Immediate Impact of COVID-19 on consumption behavior
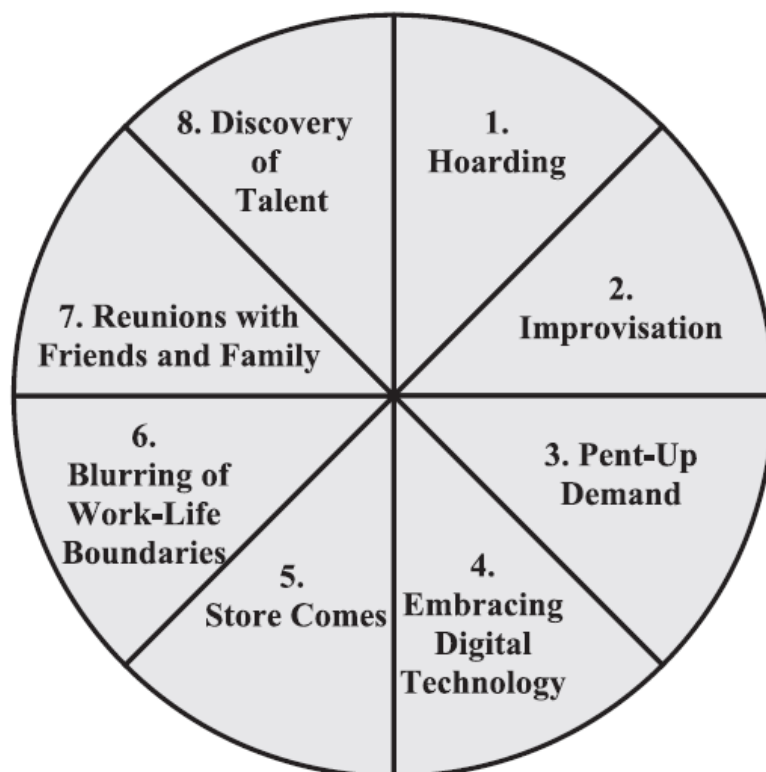
Source: (Sheth 2020)

1. Hoarding: It is a natural reaction from human beings when dealing with uncertainty. Consumers start to buy more essential products than needed causing shortages. For

example: In some areas, toilet paper, shelf-stable food, beverages, and cleaning supplies were among the scarcest items when the global pandemic was declared.

2. Improvisation: When facing limitations, people invent new ways of consuming. During the pandemic, some traditional events were held but in a different way, such as performing video consults (telehealth), homeschooling, sidewalks weddings, and funerals on zoom to keep social distancing.

3. Pent-up Demand: When access to the market is limited for some time, pent-up demand is expected, especially during crises like the coronavirus outbreak. In other words, people will postpone some purchases such as houses, cars, or concerts to the future.

4. Embracing Digital Technology: People started to use new technologies and applications to switch from traditional activities into virtual ones. A clear example of this was the adoption of zoom for meetings, health consults, and online classes.

5. Store Comes Home: To meet the regulations of staying at home and keep social distancing, consumers had to explore new alternatives for grocery shopping changing from offline to online.

6. Blurring of Work-Life Boundaries: In order to be efficient at home, it is necessary for people to work under some timetables to establish the time given to each activity or task since we were all forced to stay at home.

7. Reunions with Friends and Family: This was one of the biggest challenges to everyone since group gatherings were banned. Therefore, new alternatives were adopted such as zoom calls or WhatsApp conversations. Social media was key to keep in communication with family and friends.

8. Discovery of Talent: Due to quarantine, staying at home was not an option, so people invest some of their free time on trying new things such as cooking, play music, teaching, and shop online in a more creative way. As a result, some of them even show their talent on platforms like YouTube, creating a viral effect.

Additionally, consumers complained that during COVID-19 pandemic, essential hygiene goods like masks, gloves, hand sanitizer, and necessary household items were sold at exorbitant prices. For example, masks in Germany were sold at 13.52 Euro, 3000% more than their regular price. For this reason, customers in Kenya received refunds after a grocery chain increased the prices of hand sanitizer. These actions were controlled in countries like France, Greece, India, Italy, Kenya, and Nigeria when price regulations were implemented. (Statista 2021a).

Representatives of The Consumer Protection Cooperation network from the European Union released a joint statement identifying the most frequent scams and discriminatory practices experienced by consumers during the pandemic. Thanks to all the online portal operators who reported all these fraudulent activities to the authorities, this was possible. The main goal of the consumer protection agencies is to protect consumers, especially during the economic crisis brought upon us by COVID 19 (Pamela Coke Hamilton 2020).

2.6.3 COVID-19 impact on the grocery retail market

The ongoing coronavirus disease (COVID-19) pandemic had a significant impact on the global retail market, forcing retailers to develop new strategies to improve the efficiency of grocery shopping. In 2020, the e-commerce category that reported the highest growth in the US was food and beverage. *(Bryk 2021)*

Figure 11. US Retail Ecommerce Sales Growth, by Product Category in May 2020

Source: (eMarketer 2020)

According to a recent study made in the United States (Gelles 2020), every type of grocery store has reported increased consumer' grocery spending. Still, the most significant growth seen by online retailers is the grocery market. Grocery delivery services have also registered a rise in demand. However, the disproportion between supply and demand has brought challenges to this sector.

The "brick and mortar" shops are the biggest rivals for all e-grocery retailers in terms of the competitive grocery market and their substantial market share, but other e-retailers are also part of the competitive framework in the e-grocery retail industry *(Saskia, Mareï, and Blanquart 2016)*.

2.6.4 COVID-19 Effects on the Grocery Supply Chain

Grocery supply chains are being pushed to their limits as the world reacts to the COVID-19 pandemic. Following the recommendations to main social distance, more and more people have changed from offline stores to online shopping. This switch has generated a significant challenge to companies who had to increase their capacity in order to meet customer's demands.

A variety of factors influences the implementation of automation systems in the warehouses. A crisis, as the COVID-19 pandemic demonstrated, can be one of the most influential drivers. It has been a catalyst for change by maximizing the industry's challenges and offering tools to solve them.

2.7 Theoretical approach

2.7.1 Introduction

There are several theories regarding social sciences, but the most popular are the individual, organizational, group, and social approaches. In this case, individual theories will be studied since they focus on the individual's growth, cognitive behavior, personality, learning, and interpersonal relations (Anfara Jr and Mertz 2014).

Consumer theory and random utility theory (RUT) provide the grounds for this investigation of the potential demand of e-grocery in the usage of online channels. As a result, the framework will be based mainly on microeconomics topics.

This chapter will guide the research by defining the relevant concepts for the study and determining how they might relate to each other. First, section 2.2.2 explains the experimental design, including factorial and factorial design, followed by the random utility theory in Section 2.2.3. Further, Section 2.2.4 describes the approach of consumer behavior. Section 2.2.5 closes this chapter with a brief explanation of all the previous studies regarding retailing and, more specifically, the grocery market.

2.7.2 Theory of consumer behavior

In microeconomics, the consumer is considered a fundamental decision unit (Mas-Colell, Whinston, and Green 1995). Therefore, it is crucial to learn about people's interests and income as these variables affect the economy. To be clear, the theory of the consumer studies the way people decide to spend their money based on their preferences and financial constraints. In other words, individuals have the freedom to choose from various commodities (goods and services). Still, before making a decision, they will consider the budget they have available and the prices in the market (Koutsoyiannis 1975).

This theory has received much critics because it relies on many assumptions. One of the basic assumptions about the conduct of an individual that this approach follows is utility maximization.

According to (Barten and Böhm 1982), consumer theory uses the utility variable to show individual preferences. In other words, when it comes to shopping, people will always make their choice expecting to receive a significant benefit or the highest satisfaction (utility maximization). The main goal of consumer theory is to help firms predict individual purchasing patterns and give economists a better understanding of the actual situation of the economy in general.

2.7.3 Random Utility Theory

(Cascetta 2009) affirms that the most commonly used theoretical framework for modeling choices associated with transportation and, more widely, choices among discrete alternatives is Random Utility Theory (RUT). This paradigm allows determining various models with

diverse functional forms that can also be applied to a broad range of contexts. Besides, its mathematical properties and its parameter's calculation can be studied using well-known statistical techniques.

RUT is founded on the assumption that each person is a rational decision-maker who seeks to maximize its utility in relation to their choices.

2.7.3.1 Discrete choice modeling

There are two formal theories that can be used to explain discrete choice models. One is called Luce's strict utility theory, and the other one is the random utility theory proposed by Thurstone. The first theory presumed that selecting a choice alternative is equal to the ratio of the utility correlated to that alternative to the total utilities for all the options in the choice set. In other words, Luce proposed a constant-ratio decision rule based on deterministic preference structures. In contrast, Thurstone's random utility theory is based on stochastic preferences, with a person drawing a utility function at random on each choice event. It should be noted that a deterministic component and a random utility component are believed to be part of an individual's utility for a choice option (Timmermans 2001).

According to (Ben-Akiva and Lerman 2018), discrete choice models operate under the rational choice framework. It means that when a set of choices is given, individuals will select the one that provides the maximal benefit or utility. With this in mind, we can assume that DCM models seek to explain and predict the choices made by people from a set of two or more defined alternatives. A discrete choice model with more than two alternatives is called the multinomial logit (NML) model and is the most well-known modeling method among practitioners.

2.7.4 Experimental design

Although economists and econometricians might not be familiar with the definition of designed experiments, it is quite popular in fields like engineering, statistics, marketing, and other sciences (Louviere, Hensher, and Swait 2000). In general, every experiment includes a manipulated variable called a "factor" with one or more observations, where the values manipulated receive the name of "factor levels". However, other disciplines have adopted the term "attributes" and "attribute levels" especially when referring to characteristics of

products or services. Therefore, for this research, we will use the word "attributes" instead of "factor".

In order to make clear what an experimental design is, we will follow the definition given by (Louviere, Hensher, and Swait 2000) which defines it as "a way of manipulating attributes and their levels to permit rigorous testing of certain hypotheses of interest".

(Kirk 2012) states that an experimental design includes five tasks that are interconnected:

1. Stablish the statistical hypotheses that are relevant to the scientific hypotheses.
2. Identify the different variables involved: the experimental environment (independent variable), the calculation (dependent variable) to be registered and the additional conditions (nuisance variables) to be controlled.
3. Indicate the number of subjects needed and the population.
4. The protocol to assign the subjects to the experimental environment needs to be stated.
5. The statistical analysis that will be executed is determined.

In general, an experimental design specifies the independent, dependent, and nuisance variables as well as the procedure in which the randomization and statistical analysis need to be followed.

The design of an experiment combines attribute levels variations that characterize the different alternatives in a systematic way. After creating a pre-determined set of choices, the next step is that respondents select from a given choice set the one that suits better to their needs (Marcucci et al. 2021). With this in mind, people living in Oslo will be asked to complete 6 different choice tasks. The respondents will find a hypothetical scenario with three different alternatives (home delivery, click and pick, and in-store) considering 6 pre-defined attributes and they will have to choose the best option based on their preferences.

2.7.4.1 Factorial design

The combination of each level of each attribute with every level of all the attributes is called factorial design. It is essential to highlight that a factorial design can have two or more attributes, which can also have two or more different levels (Louviere, Hensher, and Swait 2000). In terms of estimating the parameters of linear models or testing hypotheses based on these models, the factorial design is helpful due to its statistical properties.

Full factorial design

All possible attribute levels combinations are considered a factorial design, and the complete enumeration of that combinations can also be called "complete factorial" or "full factorial." Therefore, the statistical effects of interest in these models can be determined independently of one another. (Louviere, Hensher, and Swait 2000). Derived from a full factorial, it is possible to estimate all the effects of the analysis of variance (ANOVA) or multiple linear regression models. In the case of ANOVA and multiple regression models, the effects of interest can be means, variances, and regression parameters or slopes, respectively.

However, this type of design is mainly used in minor problems with a few attributes and levels. On the other hand, in cases where the SP problems are too big, it is difficult to use full factorial. Therefore, researchers use fractional designs instead. The calculation of the total number of choice tasks can be obtained using the formula (2.1)

$$S = \pi_{j=1}^{J} \pi_{K=1}^{Kj} l_{jk} \qquad\qquad (2.1)$$

Where J represents alternatives,

K_j represents attributes, $k \in K_j$

L_{jk} represents levels for the j alternative and k attribute

Fractional factorial designs

A explained by (Louviere, Hensher, and Swait 2000), a fractional design includes selecting a subset or sample from the complete factorial design to estimate the possible effect of the main interest under the assumption that some interactions are not relevant.

In model results, the term "effect" is often used to refer to the "comparison of the means of the factor levels by means of orthogonal constraints (2000).

Orthogonal designs

Orthogonal means "uncorrelated" and it usually applies to ANOVA. The main characteristic of an orthogonal ANOVA is that all the independent variables are uncorrelated. In contrary, if one or more variables are correlated is it considered *non-orthogonal (Louviere, Hensher,*

and Swait 2000). General linear models (GLMs) are an example of non-orthogonal because they usually have at least one independent variable that is not categorical.

It is important to understand the orthogonality since it affects the way statistical test are run. Orthogonal models have only one way to calculate model parameters and run statistical tests while the results taken from non-orthogonal models can be more difficult to interpret due to the several ways to do it. In conclusion, the more correlation the independent variables have, the more carefully we should interpret the results.

3. Grocery Retail Market in Norway

The section will discuss the grocery retail market in Norway to better understand the investigation being carried out. There are many segments in the grocery retailing industry in Norway and many companies of varying size target different segments of the market. The figure below will illustrate the market share of various segments in Norwegian grocery retail market.

Figure 12. Segments Market Share
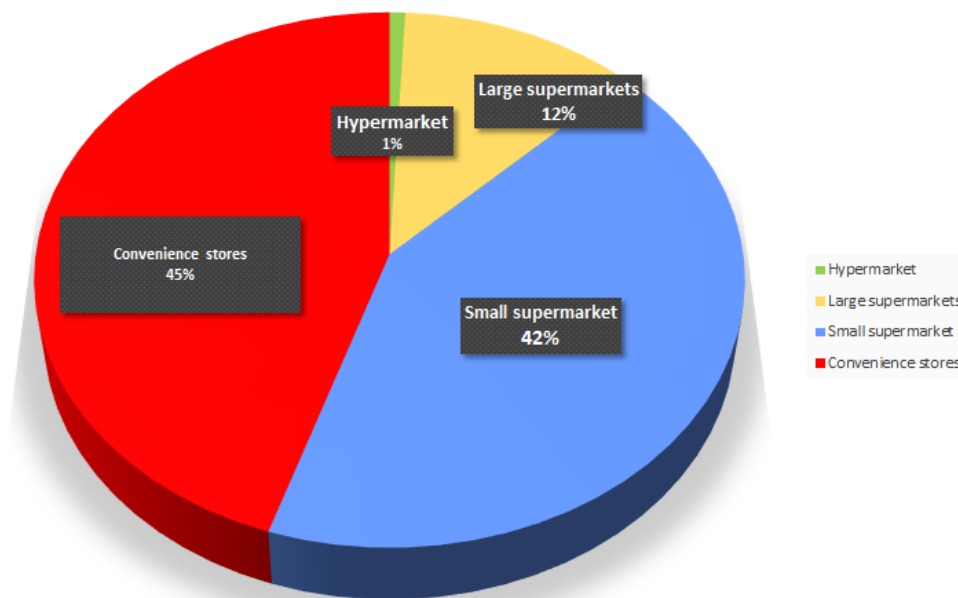
Source:(Nielsen 2016)

Hypermarket is defined by (StoreNorskeLeksikon 2018)as a large shopping outlet with a minimum size of 20,000 square meters that is owned by one person or a group of people.

The product selection consists of approximately 60-70% of grocery related items and 30% - 40% other leisure related and household items. The sales area of the hypermarket is planned like a warehouse with products stacked at various heights. Hypermarkets mostly operates self-service mode but can have manned stations as well. There are 3 hypermarkets in Oslo operated by the retailer Coop OBS (Nielsen 2016).

Supermarkets are bigger versions of a grocery store with range of products to cover the daily needs of consumers. Fresh produce like vegetables, fruits, meats and other can be found in one store location. Nielsen (2016) classifies large supermarkets to have a business area of 1000 – 2500 square meter and small supermarkets to have an area of 400 – 1000 square meter. Big grocery retailers like Norgesgruppen operates different sizes of with different strategies. Kiwi under Norgesgruppen is run as a discount chain with low priced products whiles MENY and SPAR are supermarket chains (NorgesGruppen AS 2020). Other examples of supermarket chains operating in Oslo includes Rema 1000, Bunnpris, Coop.

Convenience stores are compact or mini marts that are often open until late and are strategically located to the convenience of the consumer. These stores usually have a business area of 400 square meters and below (Nielsen 2016). In Oslo, some convenience stores offer hot food and pastries are located at train and bus stations. Convenience stores have limited groceries but offer small selection of beverages, bread, milk, and newspapers. Examples of these includes Joker, Deli de Luca, 7 eleven and Matkroken.

The discount stores concept overlaps many of the segments mentioned above. Most of the key grocery chains operate supermarkets brands with low prices geared at driving demand. These stores rely on pricing as a marketing tool to sell more products. Discount stores can be found in specialty retail and variety products but its more often focused on the wholesale products and products that are nearing or at the end of the season. Examples of these includes Rema 1000, Coop Prix, Coop Extra and Kiwi (Nielsen 2016).

3.1 Key Grocery Retailers in Norway

In Norway there are few players in the grocery retail industry, but the competition is still stiff. There are 3 key grocery chains in Norway including Reitangruppen, Coop Norge SA and NorgesGruppen (Virke Enterprise Federation 2017). NorgesGruppen operating four other chains; Kiwi, SPAR, Meny and Joker is the biggest player in the grocery retail industry. The second largest is Coop Norge AS with Reitangruppen being the smallest of the three. Additionally, Bunnpris is a smaller chain but significant player in Norway. Both NorgesGruppen and Coop have several chain brands while Reitangruppen and Bunnpris

only have one brand for their grocery stores. The three major players also operate as grocery wholesalers. ASKO is also part of NorgesGruppen and Norway's largest grocery wholesaler (ASKO 2020). Other grocery stores including company that sell products solely online account for 0.1% of market share in total.

The table below illustrates the market share of the key grocery retailers in Norway.

Figure 13. Market Share of Norwegian grocery retailers in 2019
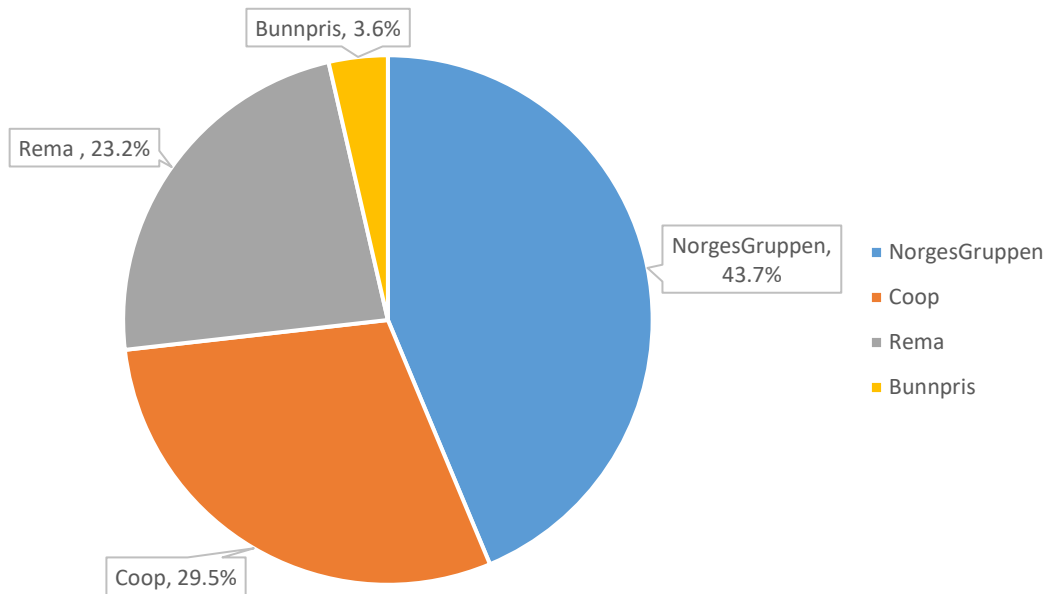
Source: (Statista 2020)

According to Dreyer and Bakås (2017), the online retail sector in Norway is primarily split between pure internet retailers and omni-channel retailers. NorgesGruppen and Coop both operate online stores together with physical stores, making them omnichannel retailers. Under NorgesGruppen, brands like MENY, SPAR and Joker all have e-groceries shops (Virke Enterprise Federation 2017).

3.1.1 NorgesGruppen

This grocery retailer has over 300 subsidiaries and is thought to be the biggest by market share. Norgesgruppen has 1820 stores located in 89 percent of Norway's municipalities (NorgesGruppen AS 2020). The company make strategic partnerships with both large and small suppliers to be able to offer a wide range of products and maintain it low price strategy. They also own brands which are produced by other business partners. According to the 2020

annual reported the NorgesGruppen exceeded 100 billion NOK in turnover in 2020, an increase of more than 10 billion NOK from 2019. This growth amongst other things is attributed to the closed borders with Sweden due to coronavirus outbreak (NorgesGruppen AS 2020) . Since Norwegians had to do all of their grocery shopping in Norway rather than in Sweden previously due to the pandemic, the company saw record sales in stores close to the border. The table below shows the different chains under Norgesgruppen and their business strategies.

Table 1. Chains, concepts & strategy under NorgesGruppen

Chain	Concept	Type
KIWI	Discount stores	Brick & Mortar
MENY	Supermarket	Omni-channel
SPAR	Supermarket	Omni-channel
Joker	Convenience store	Omni-channel
Deli de luca	Convenience store	Brick & Mortar
Mix	Convenience Store	Brick & Mortar
ASKO	Wholesale	Warehouse

The market share consumer grocery stores within Norgesgruppen illustrated in *figure 3*.

Figure 14. Market Share of NorgesGruppen Chains
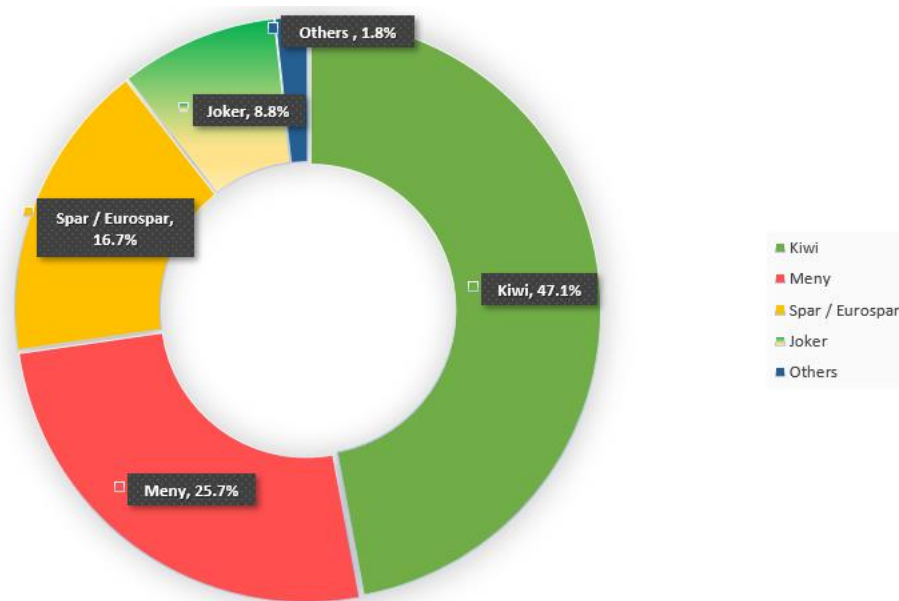
Source: (Nielsen 2017)

Kiwi had the highest growth of 19.1% amongst the chains in Norgesgruppen in 2020. Although the adverse effects of COVID-19 such as layoffs, restrictions, and general fear in going out influence grocery shopping behavior, Kiwi managed to record strong growth. Kiwi has 686 stores and an annual turnover of 46.3 billion NOK in 2020 (NorgesGruppen AS 2020)

Meny runs a supermarket concept that focuses on product selection and quality of fresh produce. The supermarket chain had an annual turnover of 21.3 billion NOK for 2020 with 184 stores. Meny's internet sales climbed by 116%, resulting in a turnover of 728 million NOK, up 400 million NOK from the previous year 2019. Meny is a multichannel chain and so has an online channel with home delivery and click & pickup options. Despite the adverse effect of the coronavirus on businesses in 2020, Meny is reported to have captured market share and gained an overall and comparable growth of 17.5% with a record number of 45 million visitors on the meny.no grocery channel in 2020 (NorgesGruppen AS 2020). The chain opened the northernmost operating online store in Eide Handel, Tromsø during the fall of 2020 (NorgesGruppen AS 2020).

Spar is also a multi-channel supermarket chain within the group with focus on making a wide range of products available, throughout the country. The total number of stores is 295 with Norgesgruppen owing 117 of those and the rest being retailer owned or franchised. The annual turnover for the year 2020 was 14.5 billion NOK and a comparable growth of 11.5 % (NorgesGruppen AS 2020).

Joker achieved a comparable growth of 11.4% and a turnover of 8.3 billion NOK in 2020. Like Meny and SPAR chains, joker offers online shopping channel with home delivery or click and pick options. Joker has improved its standing in the convenience store market even through the raging coronavirus pandemic in 2020 (NorgesGruppen AS 2020).

ASKO is Norway's largest grocery distributor and is part of NorgesGruppen. The company is the supplier of all of NorgesGruppen's stores, as well as Bunnpris. ASKO offers a well-established national distribution network that offers the best possible price and quality for merchants. AKSO has 13 regional facilities, 9 storcash stores for professional market, a central warehouse and group terminal at Vestby in Akershus (ASKO 2020).

NorgesGruppen owns and operates various convenience stores both directly and indirectly, in addition to the brands indicated above. These chains have also achieved some growth in 2020, including Mix, Deli de Luca, Kaffebrenneriet and Jafs.

3.1.2 Coop Norge SA

Coop is a cooperative owned by over owned b1.9million through membership in one of Coop's 64 cooperatives. Coop Norge uses bargaining power of the cooperative for purchasing, supply of goods and chain operations. In November 2017 Coop Norge Handel merge into Coop Norge SA (Coop Norge SA 2021). According to Nielsen (2017) Coop is the second largest retail company in Norway and operates approximately 1221 grocery stores in six chain concepts: Obs, Extra, Coop Prix, Coop Mega, Coop Market, Matkroken and two "do it yourself" DIY home improvement chains. Coop currently has 1.5 million members and an annual turnover of 45 billion NOK. The subsidiary company Coop Norway Handel AS is responsible for Coop's public procurement, wholesale and logistics operations, brand management, branding and membership program.

Coop and Posten Norge launched grocery home deliveries in Norway during COVID-19 lockdown restrictions for customers who were not able to go to the store. At the time of writing this thesis Covid-19 is still regarded as a global pandemic and coop's online store matlevering.coop.no is operational and offers home delivery service for grocery purchase through Norwegian postal company Posten.

3.1.3 Pure E-grocery Retailers

E-grocery retailers in Norway mostly operating under 2 different business models. One model is to receive customers' orders of selected grocery items, process and deliver the orders to the customers at their homes or pickup points. The second model prepacks lunch and dinner boxes including recipes and the groceries needed for the consumer to make the meals. The quantity of groceries in the boxes are portioned according to the number of people and the number of days consumers order for. Kolonial now known as Oda, Adams Matkasse, and Godtlevert now merged into Brandhub are the major companies in the pure online grocery shopping sector right now (Svendsen and Moland 2017) In addition, due to their limited market share, many other small e-grocery retailers operating in Oslo will not be mentioned in this chapter.

3.1.3.1 Oda

In preparation of becoming a global company and the imminent international expansion, Kolonial is refreshing its brand proposition and changing its name to Oda at the time this

report is being written. Oda is the biggest online grocery business in Norway providing high quality groceries to many consumers with same or next day home delivery. This change comes because the company was able to raise a funding of 223 million euros to facilitate it mission to become the most effective online grocery retailer in the world. Oda now has a market share of over 70% of online grocery orders in Norway and wants to use the funds to expand internationally. It has begun building on a state-of-the-art fulfillment center in Finland, which will open later this year in Helsinki. Oda also wants to deploy its service in Germany in 2022 and is in talks with potential partners (Prosus 2021). In the best-seller category of items, Oda competes with KIWI, Bunnpris, and Rema 1000 on price. Oda is primarily active in the Oslo and Østland areas at the moment. Oda's shipping costs vary depending on the size of the basket and the delivery time window chosen by the customer. Smaller orders and delivery time windows can also increase the service cost and vice versa (Oda 2021).

3.1.3.2 BrandHub AS

Godtlevert.no AS and Adams Matkasse AS have merged under the parent company Brandhub AS to become one of the largest e-grocery retailers in Norway. In addition, Brandhub has launched Proviant, a low-cost grocery retailer. The companies sell prepacked boxes for lunch and dinner with the recipes and grocery ingredient by home delivery option to customers but however plans to increase their variety and services in the future. Brandhub AS reportedly has a turnover of more than 700 million NOK.

The companies work with some of Norway's best food suppliers and purchase the vast majority of the raw materials directly from carefully selected suppliers. Godtlevert, Adams Matkasse and Proviant exist as competing brands under Brandhud AS. Adams Matkasse and Godtlevert.no have annual revenue bases of NOK 330 million and NOK 390 million, respectively, with close to 25 000 and 30 000 customers. The two brands will continue to function as separate concepts, with resources dedicated to strengthening and improving each other (Godt Levert 2021).

4. Methodology

4.1 Introduction

The research methods used in this project will be presented in this chapter. Attributes and their respective levels have been adopted earlier through exploring previous literature on the subject area. To begin the methodology, problem descriptions are fine-tuned, and qualitative studies are conducted to refine the list of alternatives, attributes, and their respective levels. On February 8, 2021, a focus group interview was held in Oslo to gain a better understanding of residents' attitudes toward e-grocery shopping. This study also uses the focus group interview to reaffirm the specific attributes list and attribute levels adapted that will be used in the stated preference survey. A pilot SP survey is administered to 60 participants to test the efficiency of the design adopted. The main questionnaire is used to gather 204 interviews due to low response rate, including the 60-preliminary data from the pilot test. Louviere, Hensher, and Swait (2000) states that a stated preference approach to project requires a continual evolution and therefore houses several intertwined steps in a framework. Figure 2.3 below depicts the steps taken to conduct the SP experiments.

Figure 15. Structure of the Methodology
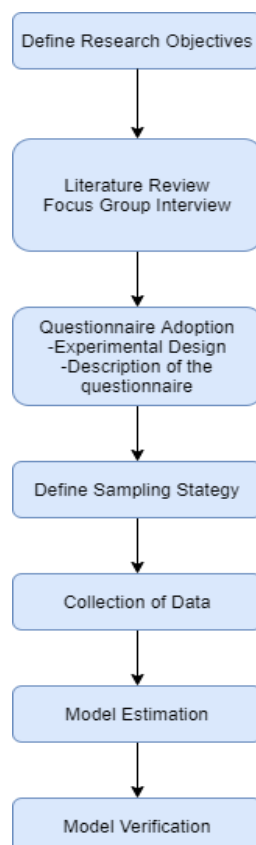
4.2 Define Research Objectives

The aim of the study is to investigate the potential market for e-grocery among residents of Oslo. The study models the consumer channel choice between online and offline alternatives to fine tune the problem. The stated preference experiments are used to address the following questions: What is the potential demand for e-grocery in Oslo?

4.3 Data Collection Method

Data is collected in a variety of ways. For the purpose of this study, the questionnaire was designed by adapting from a previous study (Marcucci et al. 2021) and through a focus group interview as supporting qualitative approach, attributes and levels are reaffirmed. The focus group interview also enables the researchers to gain better understanding of the Norwegian e-grocery landscape. The following section will go through all of the data collection methods in detail.

4.3.1 Focus Group Interview

Focus group interviews are another form of qualitative research that was used to as supportive instrument for this study. The interviews are conducted with the aim of listening and collecting information. According to Krueger (2014) the aim of a focus group meeting is to motivate participants to self-disclose information. Participants with similar characteristics are chosen concerning the topic of grocery shopping. Due to its flexible structure, focus group interviews are the most appropriate for conducting an unstructured or semi-instructed interview. Though the focus group follows a prepared set of questions the researchers can delve deeper into interesting issues raise with follow up questions. The key disadvantage of this data collection method is that the contact between interviewers can cause participants to influence one another. Furthermore, it is possible to raise biased responses Rogers, Sharp, and Preece (2011) (Lazar, Feng, and Hochheiser 2017). One focus group interview for this study was performed on 15th March 2020. The aim was to identify aspects of grocery shopping, both online and in store, that can make either channel it attractive to use or unattractive. Since the primary attributes that characterizes the alternatives in the SP experiments were adopted from literature, the focus group acted as checker to see if the attributes are still applicable and relevant in the current time of this study. Furthermore, a focus group interview is used to uncover possible attitudinal questions

for inclusion in the SP survey. Lastly the data and interactions of participants in the focus group interview set the basis for development of a shopping diary.

4.3.2 Questionnaire

Questionnaire is well-established approach that can be used for both closed and open questions to collect people's opinions and demographic data. Simple demographic information and data about user experience should be included in questionnaires. More relevant questions may be structured to contribute to the assessment objective after the general questions have been answered. Check boxes, scales, range, and ratings are different question formats that can be used (Rogers, Sharp, and Preece 2011). Typically, a questionnaire is self-administered by the participant and as a result the data gathered is not as comprehensive as the focus group interview. In order to gain deeper understanding of a subject matter, questionnaires are sometimes used in conjunction with other approaches and methods. Questionnaires enables fast data collection (Rogers, Sharp, and Preece 2011, Lazar, Feng, and Hochheiser 2017)

This study uses one main questionnaire to collect the data. This questionnaire was not developed from scratch due to the motivation for this thesis. However, this study adopts the questionnaire from previous studies (Marcucci et al. 2021) and it to be able to capture data that would be relevant to the time the study is being conducted and the scope. Through supported data from the focus group interview some new questions are added and some old questions are taken out. The questionnaire is put on an e-survey platform called Nettskjema so that data can be collected while observing the COVID-19 infection control rules. The questionnaire is translated and administered in both Norsk and English to increase the probability of the response rates. Data from the e-survey platform Nettskjema is exported back to excel for the model estimations.

4.3.2.1 Questionnaire Description

A strong motivation to adopt the questionnaire from previous literature as mentioned earlier is to isolate the potential effect of Covid-19. Many researchers prefer to employ questionnaires that have already been evaluated to minimize these delays. They adjust the previous questionnaire if it does not totally correspond with the new study's concepts, such as rewording items (statements or questions) or adding new items particular to the new study (Sousa, Matson, and Dunn Lopez 2017).

Description of Pre & Post Choice Tasks

The questions in the pre choice task provide insights in the consumers current behavior and their expectations of some attributes like the delivery lead time, cost of delivery and acceptable time windows. The questionnaire also includes some open and close ended questions to ask directly to experience regarding grocery shopping during Covid-19. The data can be used to identify various market subgroups of sample for comparison.

Post choice tasks can be used to predict how E-grocery will be accepted in the near future. The social demographic questions in the post-choice section will reveal how well the sample is covered. Gender, age, and income range can enable the differentiation of one subgroup from another. The questionnaire administered on Nettskjema is attached to the Appendix section.

Description of Choice Tasks

The alternatives, attributes and levels in the choice tasks are adopted from previous literature (Marcucci et al. 2021). The table below summarizes the alternatives with attributes and attribute levels.

Figure 16. Alternatives, attributes, and levels.

Alternatives	Attributes	Levels
In-store	Product price (PP)	Stated
	Travel time (TT)	Stated
	Product range (PR)	100%
Home delivery	Prodcut rice (PP)	Pivoted: 90%, Stated (100%), 110%
	Service cost (SC_HD)	0,50,100
	Time window (TW)	30mins, 60mins, 120mins
	Product range (PR)	50%, 100%, 150%
	Lead time (LT)	1hour, 6hours, 12hours
Click & Pick	Product price (PR)	Pivoted: 90%, Stated (100%), 110%
	Travel time (TT)	Pivoted: 50%, 75%, stated (100%)
	Service cost (SC_CP)	0, 50
	Product range (PR)	50%, 100%, 150%
	Lead time (LT)	1hour ,6hours ,12hours

Source: (Marcucci et al. 2021)

4.3.3 Shopping Diary

According to Prelipcean, Susilo, and Gidófalvi (2018), individual and group travel behavior may be analyzed using travel diaries, which are widely acknowledged. The difficulty in obtaining information from travel diaries is matched with the how important and useful data

from travel diaries can be. This difficulty can be attributed to low response rates to traditional collection techniques of diary information (Prelipcean, Susilo, and Gidófalvi 2018). The three main implementation methods of travel diary surveys are memory-based travel diary declaration, automated travel diary generation and semi-automated travel diary generation (Prelipcean, Susilo, and Gidófalvi 2018). This research makes use of travel diary to observe consumption patterns of individuals in order to best analyze consumer preference.

Revealed preference methods makes use of real market decisions from actual choices people make to draw statistical inferences on values (Boyle 2003). The process of estimating people's values for environmental benefits and drawbacks begins with the development of a theoretical framework and the analysis of data from purchasing choices (prices paid and quantities purchased). Most commonly used reveal preference approach includes travel cost, hedonics and averting behavior (Boyle 2003). Hedonic approach is typically using people's choice of location for housing and work to estimate marginal willingness to pay for resource allocation changes. Travel cost is used to value the benefits of recreation trips and sites amongst other things whiles the defensive behavior are approach are typically applied to value health effect of pollution (Boyle 2003).

The shopping diary survey in this study is designed as a travel diary to collect data on shopping patterns and choices made in buying groceries by some participants for a minimum of two weeks. Reveal preference theory assumes that consumers are rational and will have considered a set of alternatives before making a purchasing decision that suits them (Kenton 2020)

The data from the shopping diary will reveal shopping frequency, distance to grocery stores, mode of transport, categories of products purchased, and amount spent. Analyzing this data will enable the paper to fairly estimate changes in travelled distances and related carbon emissions.

4.4 Experimental Design

An experiment, according to Louviere, Hensher, and Swait (2000) entails the manipulation of variables as well as the assessment of their values. If the variables reflect product features or characteristics, they are referred to as attributes or factors. The value of the attribute is referred to as levels. Full factorial design which allows for all possible combinations to be computed is used after the alternatives, attributes, number of attribute levels and attribute labels are all identified. The literature on experimental design has developed a coding format that can be applied to each attribute level. In equation, the full list of possible labeled choice

sets is given in 2.1. The calculation below show the total number of possible treatment combinations. Generally, it is common to represent the levels as 0, 1, 2 in the experimental design literature. For this case, the study uses 2, 3.

In-store

Product Price	Travel Time	Product Range	Service Cost (SC_HD)	Service Cost (SC_CP)	Lead Time (LT) [h]
Stated	Stated	100	-	-	-

Home delivery

Product Price	Travel Time	Product Range	Service Cost (SC_HD)	Service Cost (SC_CP)	Lead Time (LT) [h]
90	-	50	0	-	1
100		100	50		6
110		150	100		12

Click and pick

Product Price	Travel Time	Product Range	Service Cost (SC_HD)	Service Cost (SC_CP)	Lead Time (LT) [h]
90	50	50	-	0	1
100	75	100		50	6
110	100	150			12

Task 1 Home Delivery

Alternatives (A) = 2 because one is the traditional shopping method, so there are no combinations. Based on the formula (3.1) with attributes 4 and levels of 3 produce a result of 6561.

Task 2 Click & Pick

Alternatives (A) = 2 because one is the traditional shopping method, so there are no combinations. Also based on the formula (3.1) with attributes 4 and levels of 3 produce a result of 6561.

Task 3 Click & Pick

Alternatives (A) = 1- Click and pick is the only one with 2 levels. Using the formula (3.1) with attribute 1 and levels at 2 results in 2.

Considering all attributes and attribute levels, the equation yields (6561x6561x2) = 86, 093,442 combinations.

4.4.1 Labelled vs Unlabeled Discrete Choice Experiments

Labeled choice experiments are less abstract and can improve the result's validity (De Bekker-Grob et al. 2010). The alternatives are given names in the labelled experiments. Unlabeled experiments are those in which the alternatives are given non-specific names. The choice of whether to use labelled or unlabeled experiments is crucial. The biggest advantage of using unlabeled experiments is that they do not necessitate the detection and use of all possible alternatives in the world. According to (Hensher et al. 2005) labelled choice sets are best used to calculate alternative-specific parameter estimates.

A labelled experiment is preferred in this study because the research problem is identifying the potential demand of e-grocery through identifying people's preference with grocery shopping channels. Therefore, a specific number of alternatives related to online and offline channels will be presented to respondents to choose from. The aim is to establish the consumers' willingness to pay for particular attributes in the set (Hensher et al. 2005).

4.4.2 Fractional Factorial Design

The large total number $(86,093,442)$ of treatment combinations for alternatives, attributes and levels calculated above makes it more practical to use a fraction of the combination. The fraction of possible combinations to use can determined at random. Randomly chosen combinations, on the other hand, can result in statistically inefficient or sub-optimal designs (Hensher et al. 2005). In order to better satisfy the attribute level balance, subsets are chosen carefully, applying a simultaneous orthogonal factorial design this research. All parameters are individually estimable in an orthogonal design, which ensures attribute level balance.

Orthogonality prevents models from becoming multicollinear, and it is considered that orthogonality reduces the variance of parameter estimates. Nonetheless, orthogonality is predicted to be an exception in the select data sets and likely to be lost throughout the data set estimate procedure (Choice Metrics 2021).

According to Hensher et al. (2005) simultaneous orthogonal designs hold across all alternatives while sequential orthogonal designs hold only within each alternative and are preferred for unlabeled experiments. Due to different alternatives having different attributes and levels, simultaneous orthogonal design is more suitable for this research.

4.4.3 Efficient Designs

In efficient designs, the goal is to build a stated choice experiment that minimizes the estimated parameter standard errors. Such designs necessitate defining prior values for the parameters to be estimated in order to do so (Walker et al. 2018). Statistical efficiency will benefit the efficient design however, correlations can exist (Hensher et al. 2005).

This research adopts the S-optimality efficiency design reported in previous literature (Marcucci et al. 2021) which can be optimized for sample size.

4.4.4 Design Blocking

Blocking is a common technique for splitting an orthogonal design into smaller designs. This is done so that a single respondent is not made to answer an excessive number of choice sets. The combination of all the blocks constitutes the orthogonal design (Hensher et al. 2005).

Blocking the design adds additional uncorrelated columns with several levels which divides the design into parts. The design is divided into six blocks and a different respondent is administered a questionnaire with one block. As a result, six separate respondent's answers are needed to finish the entire design. The study used randomization to assign respondents to one of the six blocks.

4.5 Sampling Strategy

The analysis required to determine the minimal sample size requirements in terms of testing specific hypotheses for coefficients in choice experiments is described in this section. The sampling frame specifies the universe of respondents from which a finite sample of respondents is drawn in order to collect data (Louviere, Hensher, and Swait 2000). In line with the aim of analyzing grocery shopping behavior in Norway, the data sample will be taken in Norway. Due to the case study approach this research employs, the data will be predominantly taken from residents living in the Oslo municipalities. The data will be taken randomly to ensure the sample is representative of the entire population. The public health rules and restrictions in place at the time of data collection in this research prevented face to face interviews. Data is only collected via e-survey platform called Nettskjema. The survey strategy involves the use of social media and posters pasted at strategic waiting locations like bus stops, metro stations and announcement boards. Nielsen estimates that 11.6% Norwegians used e-grocery service in 2017 and this is adopted by the study to calculate the sample size.

Formula for calculating a random sample size is stated below.

$$n = N*X / (X + N - 1)$$

where, $X = Z_{\alpha/2}^2 *p*(1-p) / MOE^2$, and $Z_{\alpha/2}$ is the critical value of the Normal distribution at α/2 (e.g., for a confidence level of 95%, α is 0.05 and the critical value is 1.96), MOE is the margin of error, p is the sample proportion, and N is the population size. The samples size needed to conduct this study with 95% confidence and a margin of error to be not more than 5% based on the formula above is 384 respondents.

4.6   Data Analysis

Data analysis may be done in variety of ways. The research methodologies used, and the type of data collected (qualitative or quantitative) determines how the analysis is done. This section discusses some of the techniques that will be used to analyze the data for the research.

4.6.1 Descriptive Analysis

Descriptive analysis is useful in providing basic information about the variables in a dataset and highlighting the potential relationships between the variables. This research uses descriptive analysis to analysis the pre-interview and post-interviews of the stated preference survey as well as the socio-demographic data. The shopping diary and interview with the e-grocery retailers will also be analyzed using descriptive analysis. Patterns in the data can easily be uncovered using descriptive analysis. The majority of quantitative data analysis is based on it (Trochim and Donnelly 2006). Mean, median, mode, variance, standard deviations, and range are some of the most often used descriptive metrics (Lazar, Feng, and Hochheiser 2017). Frequency distributions are typically used in within the context of statistics and can generally be associated with charting of a normal distribution. A frequency distribution is a statistical tool that offers a visual depiction of the distribution of data within a survey. Frequency distribution is frequently used by researchers to depict or interpret the data obtained in a sample. When the mean and median of a frequency distribution are considerably different, or when it is asymmetric, it is said to be skewed.

4.6.2 Thematic Analysis

A way of examining qualitative data is thematic analysis. Thematic data analysis as an excellent tool that can be used when working in research teams and analyzing large qualitative data sets (Nowell et al. 2017).

It is typically used to describe a group of texts, such as interview transcripts. The researcher studies the data carefully in order to uncover recurring themes, subjects, ideas, and patterns of meaning. Thematic analysis is a good approach to research when trying to identify people's views, opinions, knowledge, experiences, or values from a set of qualitative data. Braun and Clarke (2006) states that a theme is a subset of facts that is relevant to the research issue. It denotes a degree of pattern or significance in the data collection. Deductive and inductive reasoning are two ways to capture the patterns in the data. Deductive reasoning works from broad to more specific theme and sometimes referred to as a "top-down" strategy. This involves starting a research from thinking about a topic of interest and narrowing it down to hypothesis that can be tested. Inductive reasoning works the opposite way by moving from specific observations to broader generalizations and theories. This is sometimes called the "bottom-up approach". Deciding on which approach to use depends on how data is coded. The data might be programmed to answer a very narrow research question (deductive technique), or it can be programmed to answer a research question that evolves over time (inductive approach) (Braun and Clarke 2006).

4.6.3 Regression Analysis

Regression analysis is a reliable method of identifying which variables have impact on a topic of interest. The process of performing a regression allows you to confidently determine which factors matter most, which factors can be ignored, and how these factors influence each other. The utility functions of all three alternatives in this study are estimated using regression analysis. According to Chatterjee, Hadi, and Price (2000) one of the most extensively used statistical approaches for analyzing multifactor data is regression analysis. The relationship between dependent and independent variables in a regression can be presented in the form of an equation or model. The formula below is used in calculation regression.

$Y = a + bX + E$

where Y is the dependent variable, X is independent variable, a is the intercept, b represents slope and E is residual.

The researcher's primary goal while doing a regression is to determine the relationship between the dependent and independent variables. One or more independent variables are chosen to help predict the dependent variable in order to forecast the dependent variable. The process of assessing whether the predictor variables are adequate enough to assist predict the dependent variable is aided by regression analysis. Regression analysis, according to (Chatterjee, Hadi, and Price 2000), is a cyclical process in which the outputs are utilized to analyze, verify, criticize, and possibly adjust the inputs. It is also suggested that, though the regression equation is the ultimate outcome, there are other by-products that must be considered throughout regression analysis. The by-products of a process can be just as useful as the end result (Chatterjee, Hadi, and Price 2000).

5. Data Presentation

This section focuses on descriptive analysis of the from the pre and post interview of the choice experiments used in this research. Due to Covid-19 and social distancing measures to minimize the infection rate, all the primary data collected for this study is done without physical face to face meetings. The platform used to collect the data is Nettskjema, an online form developed by University of Oslo. This research also collected other primary data with the use of a shopping diary which is partly analyzed descriptively. The data from the diary is to establish a pattern of grocery shopping behavior from different categories of households in Norway. Data is also collected from two pure online grocery retailers in Norway Oda and BrandHub. The data from these interviews are reported in the subsequent sections.

5.1   5.1 Pre and Post Choice Interview Descriptive Analysis.

The SP survey is implemented in 2 major ways: social media and use of posters. We designed a flyer with QR codes and pasted these in strategic waiting locations like bus stops, metro station and close to grocery stores to get more people to answer. The flyer has both Norsk and English version and can be found in the appendix section. The use of Nettskjema prevented incomplete questionnaires from being submitted and so the data cleaning process is simultaneous to the collection. Out of the expected 384 responses, we received 204 due to low response rates. Therefore, the following part will summarize descriptive statistical analysis of 204 samples.

There are 101 females and 103 male participants in the SP survey. The social and demographic data shows a reasonable spread of the sample based on age, gender, monthly budget, and number of family members in each household. The age range is 16 years and above and the data shows a majority of the sample being in mid-twenties and early thirties. This group falls within the labor force classification by Statistics Norway.

The monthly expected expenditure ranged from less than 7500 NOK a month to more 75 000 NOK than a month. The range categorization is done according to SSB S.S (2019)'s income classification with a median for all households being 45 000 NOK after tax. A study from Đikanović (2018) shows the relationship between income and expenses and found strong influence of income level on household budgeting and expense. The data from the sample shows majority spending less than 7500 NOK monthly. We estimate that even

though e-commerce has been high, people may be deciding to buy many small items and postponing the purchase of big or expensive items due to the uncertainty the Covid-19 has presented. This phenomenon is described by Sheth (2020) as pent-up demand.

The age distribution and monthly budget are shown in figures <mark>6</mark> and <mark>7</mark> below, respectively.

Figure 17. Age Distribution of the Sample
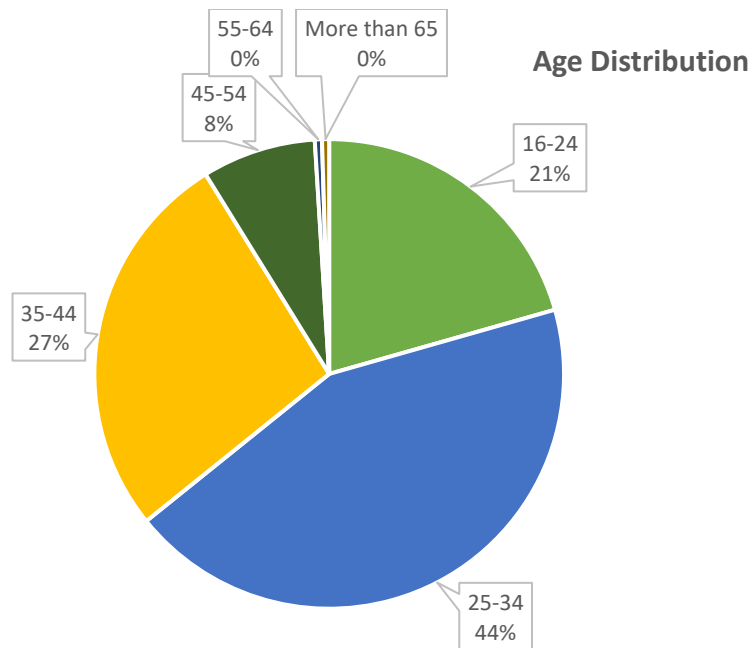
Figure 18. Income
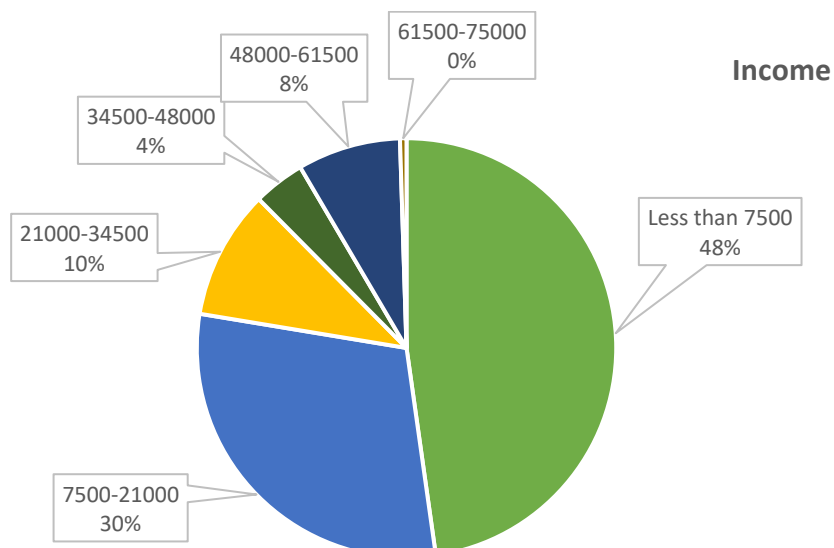
In the figure 8, the data sample show that out of the 204 respondents, majority live alone and second biggest is 19% of people living with 3 family. The majority of people living

alone can be attributed to the age sub-group. People living with 2 and 4 family members are matched at 13%.

Figure 19. Number of family members in a house
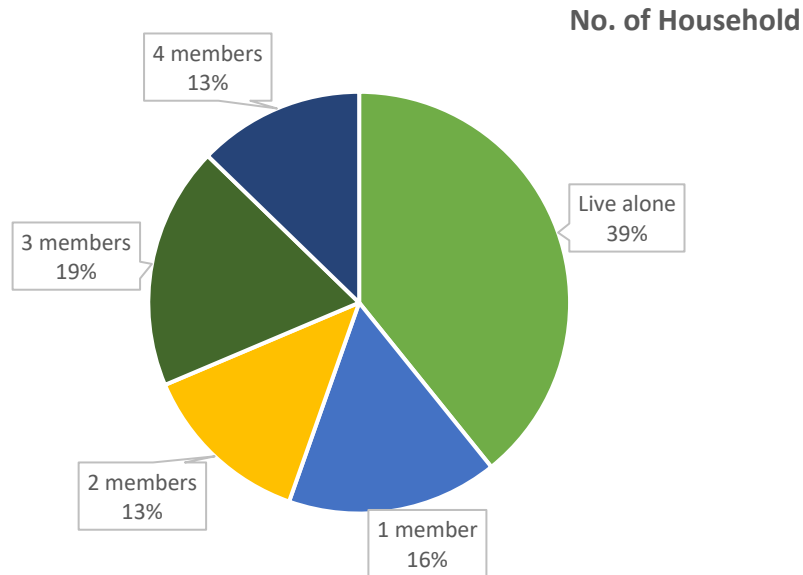
Figure 9. shows the generally awareness of the sample with regarding to e-grocery shopping. Based on questions two and three from the survey, the percentage of the people who are aware of the possibility of buying groceries online and the number of people who have actually acted on this knowledge and used the channel out of the sample is determined. Out of 167 respondents who are aware of the possibility of buying grocery in Oslo only 81 people have used the channel in the past. Figure illustrates the percentages below.

Figure 20. Awareness and past use of e-grocery channel
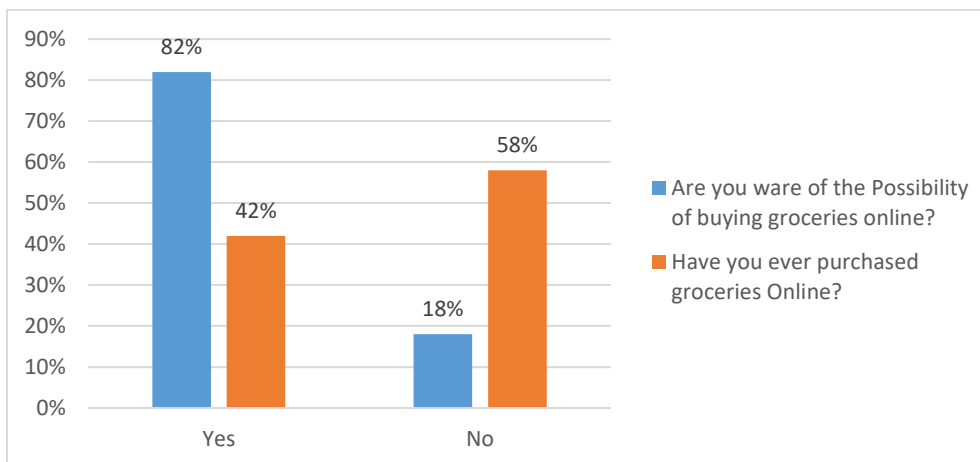
Figure 10 gives a graphic illustration of where sample prefer to buy their groceries. Majority of the data shows many people prefer to go to the supermarket. As mentioned in chapter 3, the supermarket segment has the largest share of the grocery retailer scene and so it is expected to reflect in the data. Online channel has the lowest share with only 6% of the sample claiming to use the channel for their regular grocery shopping activities.

Figure 21. Where people usually buy their groceries

Where people usually buy groceries

- Online(Oda, Godtlevert) 6%
- Hypermarket(Coop Obs) 17%
- Convenient Store(Matkroken, Joker, Asan mat 15%
- Supermarket (Meny, Kiwi, Rema, Coop) 62%
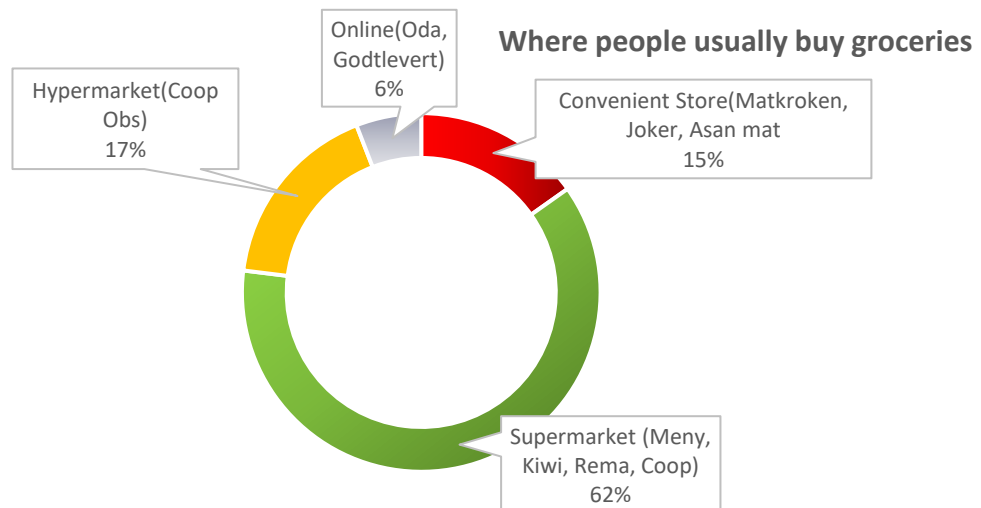
The figure 10 below depict the distribution of transport mode of the sample. Out of the 204 respondents, 68 people have personal cars that they usually use for grocery shopping and 68 people use the public transport system to go grocery shopping whiles 67 people walk to the grocery stores. This distribution almost evenly split the data. The also data shows that 160 people make dedicated trips to the store whiles 44 do not. Many people in the sample making dedicated trips may be attributed to Covid-19 quarantine rules which makes an occasional trip to the store feel like an adventure.

Figure 22. Main transport mode to buy groceries.
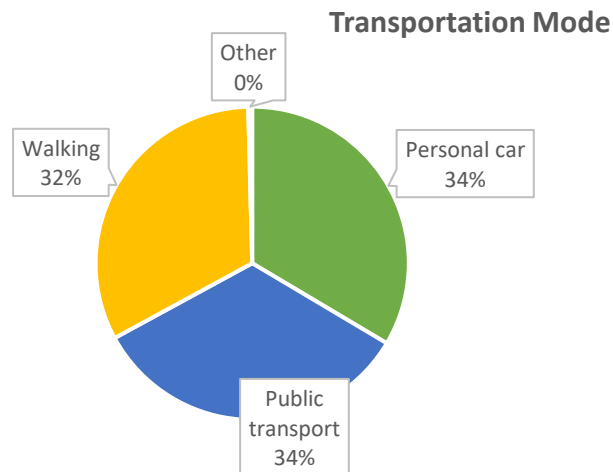
Out the 68 respondents who drive personal vehicles to the store, we can see the type of vehicle distribution of the sample shown in figure 11. 50% of the respondent using personal has said they use electric cars and the other combine 50% use cars with fossil fuels. According to a report from the International Council on Clean Transportation (2019) petrol or gasoline emits equal to a slightly lower levels of carbon CO_2 than diesel. The reports show that depending on the route, CO_2 values range from 148 g/km to 163 g/km for diesel and 140 g/km to 157 g/km for gasoline.

The relationship between carbon and emission will be discuss further in the scenario analysis. Respondents are asked about their willingness to switch e-grocery channel if it reduces carbon emissions with 85% saying they would change and 15% are not willingness to do so.

Figure 23. Vehicle Type Distribution
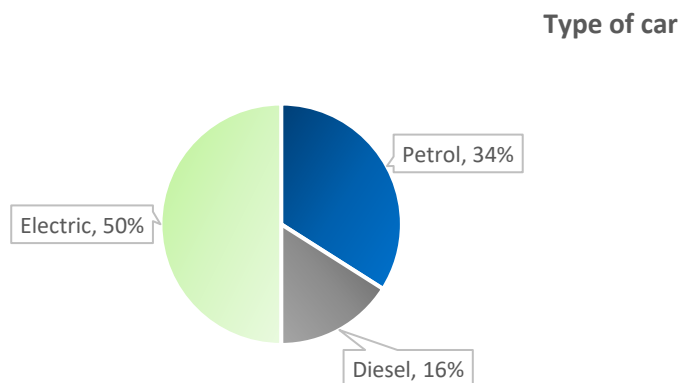
Participants are asked if the Covid-19 has had a direct influence on their grocery purchasing behavior and 34% of the sample responded yes with the remaining 64% responding no. Generally, grocery stores which are considered very essential have been allowed to open

from the start of the pandemic till today. Many grocery chains in Oslo have implemented measures to reduce infection, like period disinfection of trolleys, fridge handles, shopping baskets to make in store shopping safer. Online retailers have also increased their efforts to curb infections and deliver groceries with the same service standards. These factors may affect the distribution of the data reported. However, the chart below illustrates the fear of infections among the sample. Large percentage response to feeling safer with online channel of grocery shopping as opposed to in store.

Figure 24. Level of fear of Covid-19
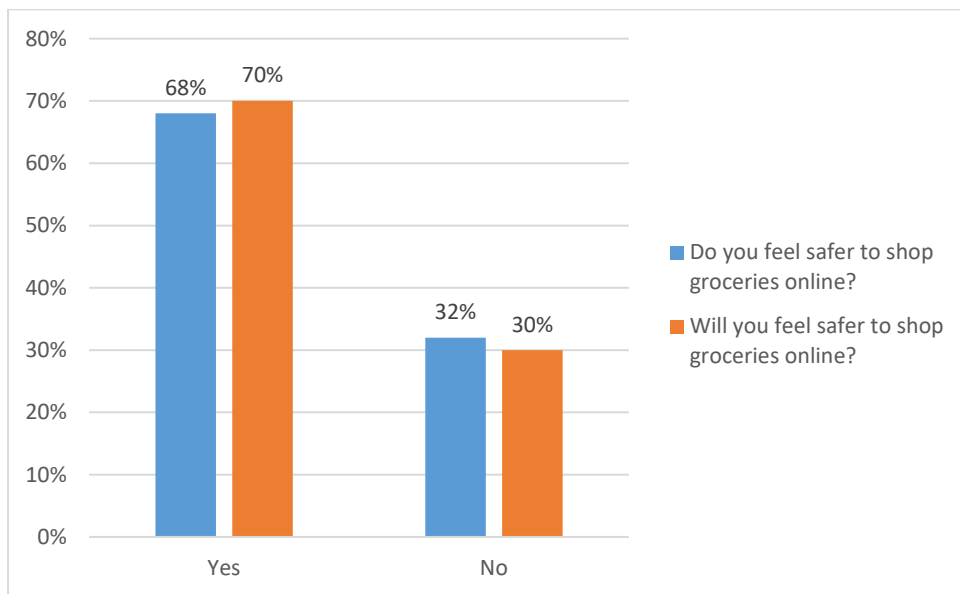
5.2 5.2 Shopping Diary Report

The data was taken from 20 households in Oslo. Participant who completed the diary are the main grocery purchasers in the household and agreed to make a record each time they go grocery shopping. Out if the 20 participants, only 1 household primarily purchases groceries with online channel.

According to the type of households that answered the shopping diary, we obtained the following results. It shows that 30% of the participants live alone; and the most recent Statistics report from SSB (2021b) in 2020 demonstrates that around 974 168 people in Norway live alone which is the category with the highest percentage.

Figure 25. Household Composition

Type of Household composition

- Living alone
- Couples without children
- Married couples with children 0-17 years
- Mother/father with children 0-17 years
- One-family households with adult children
- Cohabiting couples with children 0-17 years
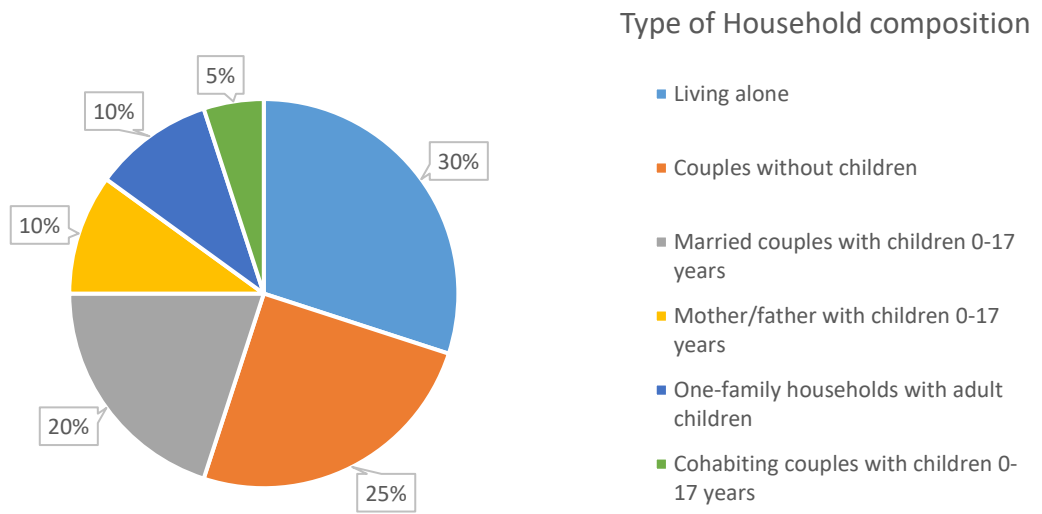
According to the data registered, households with children do dedicated trips/ planned purchases as opposed to the households without children.

Figure 26. Type of trip
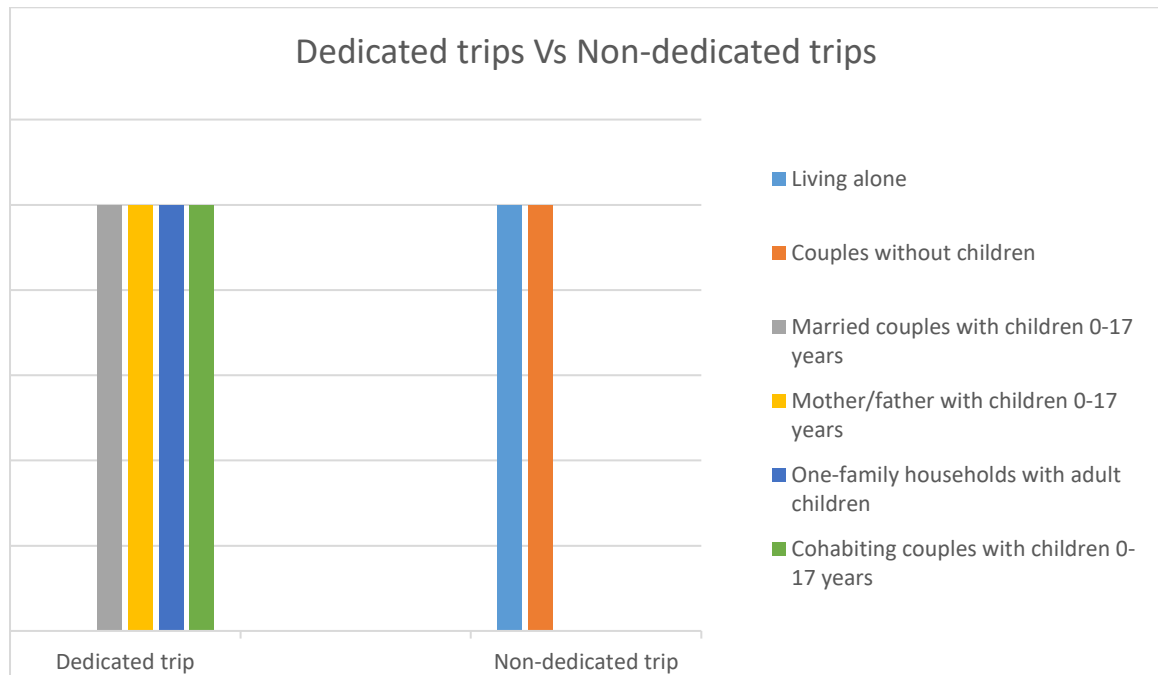
The respondents prefer to walk if the distance to the store is less than 1 km. Those who use public transport live between 1 – 5 km away from their grocery stores.

Figure 27. Mode of Transport Used

Figure 27. Mode of Transport Used
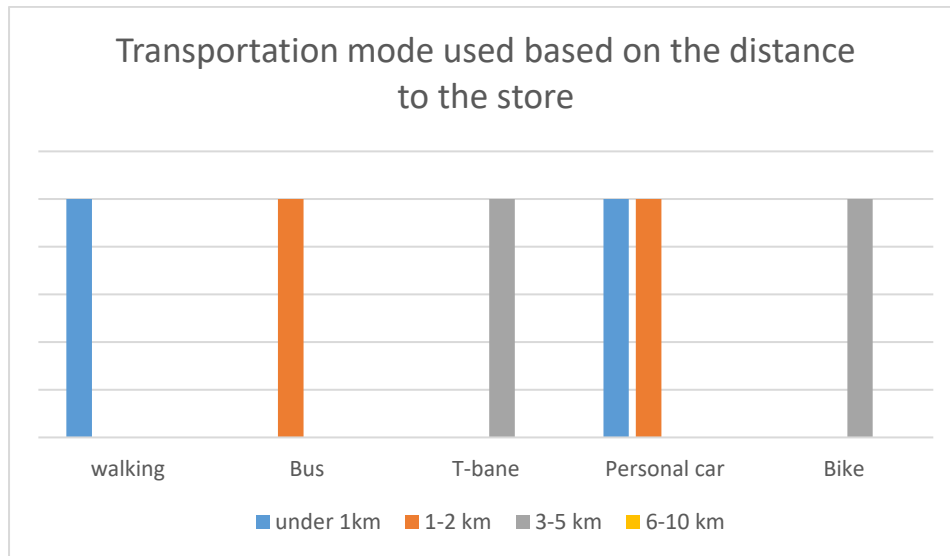
The summary of data from the shopping diary shows that the average frequency of grocery purchasing across different Norwegian households is 1 time in a week, with the average amount spent being between 300 – 500 Nok. The most popular category of food purchased every week is fruits and vegetables. Majority of the people live under 1 km distance from their grocery store and chose to walking to the store. The data also showed 8 people have personal cars and drove to the store a total of 14 times with only one using electric. The data also illustrates that 58 km driven round trip to buy groceries within two weeks with non-electric vehicles.

5.3 Company Interviews Report

This section reports the interviews held with the two key pure e-grocery retailers in Norway. The purpose of interviewing e-grocery retailers is to identify the parameters to be used for transport and environmental analysis. The questions are open-ended questions and directed towards identifying activities of outbound logistics in the company. Many emails were sent to both omni-channel and pure e-grocery retailers, but the interview was only granted by two pure e-grocery retailers, Oda (Kolonial Norge AS) and Godt Levert (BrandHub AS). Interview questions can be found in the Appendix section.

5.3.1 Oda (Kolonial)

The interview was held on 26th April 2021 between the researchers and delivery director of Oda via Microsoft teams. The company's fulfillment center is located in Lørenskog, Norway, where inbound inventories are sent to the warehouse workers to make distribution packs from the inventory according to customers' orders and package them ready to be delivered. The company uses delivery partners (3PLs) for outbound logistics operations. Oda uses a fleet of approximately 300 vans, and 90% of drivers are employed through the delivery partners. The partners are responsible for the last mile delivery, but Oda closely monitors operations to ensure that deliveries are done on time. All the vans in the fleet run on diesel engines, but the company has plans to switch to electric vehicles in the near future. Freight consolidation and routing is done by a route planner algorithm that processes some input data to generate the routes. Data including vehicle start times, weight capacity, customer addresses, and acceptable delivery time window, especially for restricted items like alcohol, goes into the planner.

However, an average of 85 km is driven per delivery trip, with the lowest distance being 30 km and the highest being 350 km. The director pointed out that Oslo has more densely located customers and so shorter kilometers are driven compared to other districts. There is an average of 29.5 one on one deliveries in a given trip.

Due to Covid-19, the company has had an increase in demand attributed to quarantine restrictions and initial general fear of infection. Increased demand has improved transport efficiency new customers spring up in an already served route. Densely located customers mean more one-on-one deliveries can be made with less travel distance. The company run out of capacity in April of 2020 and had to stop operation of some days to solve capacity constraints. Oda also started developing new products like prepacked food boxes to offer more service to its customers.

The main challenge faced by Oda is not meeting delivery quota and loosing dissatisfied customers to brick and mortar grocery chains. The company is focused on recruiting new customers and ensuring loyalty through offered premium quality groceries. Dry and cold storage operations should result in highest quality groceries just like the way the customer can get it with a trip to the store. Many customers are also not using the click and pick service even though the company has many pick up points.

Finally, the director predicts continues growth in e-grocery sector due to convenience and ease of use. He predicts a higher market share for this channel in future if they target various

customers groups and adapt to their needs. Emerging technological innovations like delivery drones, self-driven cars and mobile pick-up stations can be implemented in future to push this growth.

5.3.2 Godt Levert

The second interview is held on 19th May 2021 with the group chief operations officer of BrandHub via telephone. The company also purchases inventory from about 40 different suppliers and does the packaging of the prepacked meal boxes with many recipes offers in their warehouse facility at Furuset, Norway. Godt Levert buys transport services from approximately 15 to 20 different carriers to perform delivery to customers. The company works closely with the partners to develop the routes and ensure on-time deliveries.

Although the fleet size is not known, the company and transport partners handle about 250 delivery routes between Sunday and Monday every week. Approximately 250 drivers are delivering to customers across the country. All vehicles in the fleet, for the time being, are non-electric.

Cooling trucks are used to carry the products between the warehouse in Furuset to the hubs for last-mile delivery. The last-mile delivery is still done by one of a delivery partners but is not cooled. A normal delivery trip is not more than 6 hours because cooling trucks are not used, and the delivery time window has to be between 16:00 and 19:00 evening. The average number of one-on-one deliveries on a trip is between 50 and 70.

The effects from Covid-19 have been an increase in sales volume, which the company is enjoying, but adverse effects of this have generally being absolved by the resilient logistics operations. The challenges faced by the company also come from the competition with brick-and-mortar chains for customers in the grocery market.

6. Econometric results

This section interprets the results derived from the MNL model, starting with evaluating the overall goodness-of-fit statistics of the model. Followed by the explanation of the outcome based on the sign and significance of the coefficients. Additionally, the willingness to pay measures for each of the attributes will be described. Finally, the section ends with a brief discussion of the possible sub-samples that might produce interesting results. The output for the MNL model generated through the NLOGIT program is shown in a structured format in Table 2.

Table 2. MNL model estimations results

```
Discrete choice (multinomial logit) model
Dependent variable                 Choice
Log likelihood function     -1156.11897
Estimation based on N =   1224, K =   9
Inf.Cr.AIC  =   2330.2 AIC/N =    1.904
---------------------------------------
          Log likelihood R-sqrd R2Adj
ASCs  only  model must be fit separately
            Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
---------------------------------------
Chi-squared[ 7]          =    350.16792
Prob [ chi squared > value ] =   .00000
Response data are given as ind. choices
Number of obs.= 1224, skipped    0 obs
```

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00288***	.00081	-3.55	.0004	-.00447	-.00129
SC_HD	-.01204***	.00218	-5.52	.0000	-.01631	-.00777
TW	.00205	.00222	.93	.3546	-.00229	.00639
PR	.00483***	.00148	3.25	.0011	.00192	.00773
LT	-.07279***	.01435	-5.07	.0000	-.10091	-.04467
ASC_CP	-.26467	.19537	-1.35	.1755	-.64759	.11824
TT	-.02601***	.00518	-5.02	.0000	-.03618	-.01585
SC_CP	-.00713**	.00299	-2.39	.0170	-.01299	-.00127
ASC_SM	.31223	.28417	1.10	.2719	-.24474	.86920

***, **, * ==> Significance at 1%, 5%, 10% level.

The number of observations reported in the MNL model is the total number of alternatives chosen in the data set. Our SP experiment presented 6 choice tasks, and 204 respondents answered each choice. Therefore, there are a total of 1,224 alternatives considered by the sampled respondents.

Considering the information from table 3 as our base model, we will substitute the values in the formula to calculate the model utility functions and find a model that performs better statistically considering our expectations.

Table 3. Stated average travel time and purchase price

	Mean	St dev	Min	Max	Cases
Travel time	17.6	13.2	5	90	204
Purchase Price	622.1	505.6	100	2000	204

6.1 Goodness-of-fit Measures

In order to understand the results derived from the MNL model, it is essential to start with an evaluation of the overall goodness-of-fit statistics of the model. By measuring this, we will determine how well the model fits the data. In general, if the deviations between the observed data and the model's estimated data are minimum and unbiased, it indicates that the model fits the data well (Koppelman and Bhat 2006).

6.1.1 Pseudo R² calculation

The R-Squared value is a statistical indicator commonly used to describe the goodness-of-fit for choice models. It represents the proportion of the variance for a dependent variable that is explained by one or more independent variables in a regression model. In other words, if the R^2 of a model is 0.50, it means that half of the observed variation can be explained by the model's results. Generally, the higher the R-squared value is, the better the model fits your observation set. The formula to calculate a $pseduo\ R^2$ for a choice model is the following:

$$pseduo\ R^2 = 1 - \frac{LL_{estimated\ model}}{LL_{base\ model}} \qquad (6.1)$$

Where NLOGIT gives the estimated model:

$$LL_{Estimated\ model} = -1156.11897$$

The resulting pseudo-R^2 reflects how much variation in preference is explained by this model compared to a model estimated, assuming the choice shares observed in the sample data and comparing the LL function of this model to the suited model. For this particular case, we observed an LL function of -1344.701441 for the base model as calculated in (6.2).

$$LL_{base\ model} = (204\ X\ 6)\ X\ \ln\left(\frac{1}{3}\right) = -1344.701441 \qquad\qquad (6.2)$$

To get the Pseudo R^2 we followed the formula (6.1) and replaced the values from the estimated model and the base model:

$$pseduo\ R^2 = 1 - \frac{-1156.11897}{-1344.701441} = 0.14$$

According to McFadden (1977, p.35) "values of 0.2 to 0.4 represent an excellent fit". Thus, the $pseduo\ R^2$ value of 0.14 given in this case indicates a moderate model fit. (Hensher et al. 2005) claims that the $pseduo\ R^2$ of a choice model is not the similar to the R^2 of a linear regression model. However, there is a correlation between the two. It is important to understand that the MNL model using choice analysis is non-linear.

6.2 Sign and significance of coefficients

6.2.1 Signs of coefficients

(Koppelman and Bhat 2006) suggests that the simplest way of testing the estimation outcome is by examining the signs of the parameters with theory, intuition, and judgment with respect to the expected effect on the variables. For example, the coefficients generated in our econometric results for the purchase price, service cost, lead-time, and travel time are negative, as expected, meaning that the utility level decreases as the mode becomes higher (purchase price/service cost) or longer (lead-time/travel time).

6.2.2 Significance of coefficients

As stated by (Hensher et al. 2005), the statistical significance measures if the test outcome derived from the sample accurately represents what is happening in the population. In other words, it indicates if the conclusion drawn from the sample is reliable or not). It is represented as a probability (p-value), and it shows that the higher the value is, the more difficult it will be for the analyst to conclude that the information obtained is representative of the population.

Given that we can never be sure as to how representative a conclusion obtained from a sample is of the population (unless we take a census), statistical significance is represented in the form of a probability known as a p-value. The higher the p-value obtained for the test, the less able the analyst is to conclude that the finding obtained from the sample may be inferred to the population. The upper level of acceptable error, called alpha (represented as $\propto$), must be determined by the analyst. A p-value of 0.05 is the upper level of acceptable error most researchers use (Hensher et al. 2005).

When dealing with SP data, it is fundamental to determine constant terms (alternative specific constants). The ASCs will represent the sample choice shares for an MNL model and also represent the unobserved effects of a specific alternative. By considering the different changing variables will make the market share more realistic.

The information obtained from the MNL model estimation (table 2) is used to calculate the utility functions as follows:

$$V_{is} = 0.31223 - P0.00288P_{is} - 0.026201TT_{is} + 0.00483PR_{is}$$
$$V_{hd} = -0.00288PP_{hd} - 0.01204SC\_HD + 0.00205TW_{hd} + 0.00483PR_{hd} - 0.07279LT_{hd}$$
$$V_{cp} = -0.26467 - 0.00288\ PP_{cp} - 0.02601TT_{cp} - 0.00713SC\_CP + 0.00483PR_{cp} + 0.07279LT_{cp}$$

6.3 Willingness to Pay.

The willingness to pay (WTP) measures the amount that a customer base is willing to pay for a product or service. Typically, the WTP is represented in a monitory unit or price range. According to Hensher et al. (2005), WTP is vital for determining the value of time, and statistically significant factors must be used to obtain relevant results. The study will try to

do this by comparing two statistically significant parameters to assign a monetary unit to the attribute.

The results above show all the types of time have a negative impact except time window, which is positive and not statistically significant. This is not expected but can be due to the sample size that performed the experiment. Time window may be more significant to a larger sample or the entire population. Product range has a positive impact on cost, signifying that consumers' willingness to pay more for a wide product range but lesser travel time or lead time.

The formula below is used to calculate willingness to pay and is shown in table 4.

$$WTP_k = -\frac{\frac{\partial v_{nsj}}{\partial x_k}}{\frac{\partial v_{nsj}}{\partial x_c}} = -\frac{\beta_k}{\beta_c}$$

Table 4. WTP Values

WTP		Values of WTP	
WTP$_1$	LT:PP	-0.4212	NOK/minute
WTP$_2$	PR:PP	1.6771	
WTP$_3$	TT:PP	-9.0313	NOK/minute
WTP$_4$	LT:SC_HD	-0.1008	NOK/minute
WTP$_5$	PR:SC_HD	0.4012	
WTP$_6$	LT:SC_CP	-0.1701	NOK/minute
WTP$_7$	PR:SC_CP	0.6774	
WTP$_8$	TT:SC_CP	-3.6480	NOK/minute

The table above shows 1 minute of lead time LT equals service cost of HD 0.10 NOK, and the value of lead time for 1 hour can be 6 NOK. This means consumers are willing to pay less for an increase in delivery time. Another example is TT equals 9.0313 NOK product

price per minute and 3.648 NOK service cost CP per minute. If a customer takes long to travel and buy groceries, they would like to pay more for PP than extra service cost to save the time.

6.4 Comparisons of different subgroups in the sample

Comparisons of the sub-groups in the sample are made to understand how their utility functions are derived. This will enable marketing strategies to be targeted towards different customer segments. Some sub-groups from the sample to be used for the comparisons include gender, age, income, whether they ever bought grocery online, whether they perform dedicated or non-dedicated trips and whether Covid 19 has influenced their purchasing. The main comparisons in the sections will be identified by calculating the willingness to pay.

From the Table 5 and 6. We can see that TW is not significant and, as mentioned earlier, can be due to the fact that more people are now home-based because of Covid-19. Willingness to pay is calculated for two sub-groups with LT and SC_HD attributes. The calculation below implies that females are willing to pay more service cost in HD to reduce LT than males in this regard.

$$WTP_{Female} = -\frac{\beta_{LT}}{\beta_{ScHD}} = -3.691 \text{ (Nok/minute)}$$

$$WTP_{male} = -\frac{\beta_{LT}}{\beta_{ScHD}} = -7.405 \text{ (Nok/minute)}$$

Table 5. Gender (Female) sub-group

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00297**	.00124	-2.39	.0167	-.00540	-.00054
SC_HD	-.01374***	.00319	-4.31	.0000	-.01998	-.00749
TW	.00029	.00319	.09	.9274	-.00595	.00653
PR	.00373*	.00221	1.69	.0908	-.00059	.00806
LT	-.05072**	.02139	-2.37	.0178	-.09265	-.00879
ASC_CP	-.02773	.27422	-.10	.9195	-.56519	.50973
TT	-.06265***	.00963	-6.50	.0000	-.08153	-.04377
SC_CP	-.01195***	.00449	-2.66	.0078	-.02075	-.00314
ASC_SM	.76509*	.41304	1.85	.0640	-.04445	1.57462

***, **, * ==> Significance at 1%, 5%, 10% level.

Table 6. Gender (Male) sub-group

```
--------+-------------------------------------------------------------
        |                 Standard              Prob.      95% Confidence
   ANS_1| Coefficient     Error        z      |z|>Z*        Interval
--------+-------------------------------------------------------------
     PP|    -.00277**       .00108    -2.57    .0103     -.00489    -.00065
   SC_HD|   -.01180***      .00308    -3.84    .0001     -.01783    -.00577
     TW|     .00320         .00316     1.01    .3109     -.00299     .00938
     PR|     .00587***      .00205     2.87    .0041      .00186     .00988
     LT|    -.08738***      .01974    -4.43    .0000     -.12607    -.04868
  ASC_CP|   -.40598         .28680    -1.42    .1569     -.96810     .15614
     TT|    -.00787         .00649    -1.21    .2255     -.02060     .00486
   SC_CP|   -.00401         .00410     -.98    .3281     -.01206     .00403
  ASC_SM|    .04048         .40624      .10    .9206     -.75574     .83669
--------+-------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
Model was estimated on May 24, 2021 at 00:42:06 PM
--------------------------------------------------------------------
```

Tables 7 and 8 show the sub-group comparisons made below people below 35 and those above 35 years. In comparing the WTP between the two, results indicate that people aged above 35 years are willing to pay more in service cost to save travel time than those below 35 years. Although due to the statistical insignificance of SC_CP in subgroup 1, the results may not be as meaningful as expected.

$$WTP_{\leq 35} = -\frac{\beta_{TT}}{\beta_{PP}} = -9.164 \text{ NOK/minute}$$

$$WTP_{\leq 35} = -\frac{\beta_{TT}}{\beta_{SCcp}} = -16.725 \text{ NOK/minute}$$

$$WTP_{\geq 35} = -\frac{\beta_{TT}}{\beta_{PP}} = -6.743 \text{ NOK/minute}$$

$$WTP_{\geq 35} = -\frac{\beta_{TT}}{\beta_{SCcp}} = -2.526 \text{NOK/minute}$$

Table 7. Below 35 years old sub-group

```
--------+-------------------------------------------------------------
        |                 Standard              Prob.      95% Confidence
   ANS_1| Coefficient     Error        z      |z|>Z*        Interval
--------+-------------------------------------------------------------
     PP|    -.00219**       .00092    -2.39    .0168     -.00399    -.00040
   SC_HD|   -.00590*        .00352    -1.67    .0940     -.01280     .00100
     TW|     .00497         .00342     1.45    .1470     -.00175     .01168
     PR|     .00884***      .00226     3.92    .0001      .00441     .01326
     LT|    -.05966***      .02249    -2.65    .0080     -.10373    -.01559
  ASC_CP|   -.17194         .34896     -.49    .6222     -.85590     .51201
     TT|    -.02007**       .00920    -2.18    .0291     -.03810    -.00204
   SC_CP|   -.00120         .00494     -.24    .8073     -.01088     .00848
  ASC_SM|    .62705         .47918     1.31    .1907     -.31212    1.56622
--------+-------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
--------------------------------------------------------------------
```

Table 8. More than 35 years old sub-group

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00405**	.00164	-2.47	.0135	-.00727	-.00084
SC_HD	-.01771***	.00296	-5.98	.0000	-.02352	-.01191
TW	-.00110	.00307	-.36	.7188	-.00712	.00491
PR	.00047	.00203	.23	.8157	-.00351	.00446
LT	-.09300***	.01942	-4.79	.0000	-.13107	-.05493
ASC_CP	-.44311*	.24659	-1.80	.0723	-.92641	.04019
TT	-.02731***	.00667	-4.10	.0000	-.04037	-.01424
SC_CP	-.01081***	.00384	-2.82	.0048	-.01833	-.00329
ASC_SM	-.33357	.37322	-.89	.3714	-1.06506	.39792

***, **, * ==> Significance at 1%, 5%, 10% level.

Tables 9 and 10 below compare the results between different sub-groups with different income levels. As expected, people with income below 48 000 NOK have more time and cost attributes having a negative impact than those above 48 000 NOK. ASC_SM is negative and significant for sub-group 1 (Income above 48 000), suggesting the absence of status quo bias and positive attitude towards HD. On the other hand, subgroup 2 (below 48 000 NOK) shows a positive attitude towards the instore constant as expected.

Table 9. Income above 48 000 NOK

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00384*	.00199	-1.93	.0539	-.00775	.00006
SC_HD	-.01196	.00823	-1.45	.1464	-.02809	.00418
TW	-.00379	.00707	-.54	.5916	-.01764	.01006
PR	.00558	.00635	.88	.3789	-.00685	.01802
LT	-.10375*	.05694	-1.82	.0684	-.21536	.00785
ASC_CP	-2.29643**	1.13409	-2.02	.0429	-4.51921	-.07365
TT	-.00970	.03845	-.25	.8009	-.08506	.06567
SC_CP	-.02830**	.01418	-2.00	.0460	-.05609	-.00051
ASC_SM	-2.89210**	1.38238	-2.09	.0364	-5.60152	-.18269

***, **, * ==> Significance at 1%, 5%, 10% level.

Table 10. Income below 48 000 NOK

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00328***	.00100	-3.27	.0011	-.00524	-.00131
SC_HD	-.01416***	.00242	-5.85	.0000	-.01890	-.00942
TW	.00334	.00247	1.35	.1763	-.00150	.00817

```
      PR|      .00506***        .00158       3.20   .0014       .00196     .00815
      LT|     -.07937***        .01554      -5.11   .0000      -.10981    -.04892
  ASC_CP|     -.13927           .20617       -.68   .4993      -.54335     .26481
      TT|     -.02706***        .00537      -5.04   .0000      -.03758    -.01655
   SC_CP|     -.00554*          .00313      -1.77   .0761      -.01167     .00058
  ASC_SM|      .50807*          .30188       1.68   .0924      -.08360    1.09974
--------+----------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
------------------------------------------------------------------------
```

Tables 11 and 12 compare the sub-groups of those who have ever purchase groceries online from those who have not. We calculate the WTP for an increase in travel time to the product price to compare the two. The results indicate that people who have never purchased groceries before would like to pay higher product price if they take a longer time to travel to the grocery store than the other sub-group.

$$WTP_{yes} = -\frac{\beta_{TT}}{\beta_{PP}} = -16.948 \text{ NOK/minute}$$

$$WTP_{no} = -\frac{\beta_{TT}}{\beta_{PP}} = -4.165 \text{ NOK/minute}$$

Table 11. Sub-group who has purchased grocery online before

```
--------+----------------------------------------------------------------
        |                    Standard              Prob.       95% Confidence
   ANS_1| Coefficient        Error        z      |z|>Z*          Interval
--------+----------------------------------------------------------------
      PP|     -.00248***        .00091      -2.72   .0065      -.00427    -.00069
   SC_HD|     -.00970***        .00324      -3.00   .0027      -.01605    -.00336
      TW|     -.00064           .00302       -.21   .8327      -.00655     .00527
      PR|      .00719***        .00215       3.34   .0008       .00297     .01141
      LT|     -.01752           .02167       -.81   .4188      -.06000     .02495
  ASC_CP|     -.83689***        .32031      -2.61   .0090     -1.46468    -.20910
      TT|     -.04203***        .01049      -4.01   .0001      -.06259    -.02147
   SC_CP|     -.00124           .00476       -.26   .7947      -.01057     .00809
  ASC_SM|      .19317           .44101        .44   .6614      -.67119    1.05752
--------+----------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
------------------------------------------------------------------------
```

Table 12. Sub-group who has not purchased grocery online before

```
--------+----------------------------------------------------------------
        |                    Standard              Prob.       95% Confidence
   ANS_1| Coefficient        Error        z      |z|>Z*          Interval
--------+----------------------------------------------------------------
      PP|     -.00713***        .00191      -3.74   .0002      -.01087    -.00340
   SC_HD|     -.02335***        .00397      -5.88   .0000      -.03113    -.01557
      TW|      .01056***        .00409       2.58   .0098       .00254     .01858
```

```
     PR|      .00036         .00244        .15   .8838     -.00442      .00513
     LT|    -.15458***       .02288      -6.76   .0000     -.19942     -.10974
  ASC_CP|     .63954**       .30514       2.10   .0361      .04147     1.23761
      TT|    -.02970***      .00748      -3.97   .0001     -.04435     -.01504
   SC_CP|    -.00832**       .00422      -1.97   .0485     -.01659     -.00005
  ASC_SM|     .39912         .46417        .86   .3899     -.51063     1.30887
--------+----------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
------------------------------------------------------------------------
```

Tables 13 and 14 compare sub-groups who perform dedicated trips and those who do not. Many attributes are insignificant for sub-groups who perform non-dedicated trips except for LT and SC_CP. We estimate that people who perform non-dedicated trips tend to buy groceries only when the need arises. The shopping diary report links this subgroup to households without children. The data from the other sub-group that performs dedicated trips is in line with expectation.

Table 13. Sub-group who performs non-dedicated trips.

```
--------+----------------------------------------------------------------
        |                     Standard              Prob.     95% Confidence
  ANS_1|  Coefficient        Error        z       |z|>Z*        Interval
--------+----------------------------------------------------------------
     PP|    -.00173          .00162      -1.07    .2868     -.00491      .00145
  SC_HD|    -.00556          .00469      -1.18    .2363     -.01476      .00364
     TW|    -.00202          .00479       -.42    .6736     -.01141      .00737
     PR|     .00359          .00339       1.06    .2894     -.00305      .01023
     LT|    -.07738**        .03094      -2.50    .0124     -.13803     -.01673
  ASC_CP|   -.16888          .42485       -.40    .6910    -1.00156      .66381
     TT|    -.00684          .00914       -.75    .4543     -.02474      .01107
   SC_CP|   -.01898***       .00720      -2.64    .0084     -.03309     -.00487
  ASC_SM|    .23796          .62316        .38    .7026     -.98341     1.45934
--------+----------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
------------------------------------------------------------------------
```

Table 14. Sub-group who performs dedicated trips

```
--------+----------------------------------------------------------------
        |                     Standard              Prob.     95% Confidence
  ANS_1|  Coefficient        Error        z       |z|>Z*        Interval
--------+----------------------------------------------------------------
     PP|    -.00323***       .00095      -3.39    .0007     -.00510     -.00136
  SC_HD|    -.01385***       .00249      -5.56    .0000     -.01873     -.00897
     TW|     .00349          .00253       1.38    .1687     -.00148      .00845
     PR|     .00520***       .00167       3.12    .0018      .00193      .00847
```

```
      LT|     -.07247***       .01641     -4.42   .0000    -.10463    -.04032
  ASC_CP|     -.21308          .22379      -.95   .3410    -.65169     .22553
      TT|     -.03491***       .00634     -5.50   .0000    -.04735    -.02248
   SC_CP|     -.00476          .00334     -1.42   .1547    -.01131     .00179
  ASC_SM|      .41851          .32565      1.29   .1987    -.21975    1.05678
--------+-----------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
-------------------------------------------------------------------------
```

Tables 15 and 16 compare who said Covid 19 had influenced their purchasing from those who said no. A focus on the LT shows a unit increase in lead time causes a higher decrease in utility derived in sub-group 2(Covid affects their purchasing) than in sub 1 (Covid did not affect their purchasing) all others constant.

Table 15. Sub-group who said Covid did not influence their purchasing.

```
--------+-----------------------------------------------------------------
        |                   Standard              Prob.      95% Confidence
   ANS_1| Coefficient       Error      z        |z|>Z*        Interval
--------+-----------------------------------------------------------------
      PP|     -.00226**        .00105    -2.16    .0311    -.00432    -.00021
   SC_HD|     -.01035***       .00267    -3.88    .0001    -.01558    -.00512
      TW|      .00148          .00267     .55     .5794    -.00376     .00672
      PR|      .00507***       .00177    2.86     .0042     .00160     .00855
      LT|     -.05156***       .01740    -2.96    .0030    -.08566    -.01745
  ASC_CP|     -.15196          .23873     -.64    .5244    -.61987     .31595
      TT|     -.02230***       .00696    -3.20    .0014    -.03595    -.00866
   SC_CP|     -.01070***       .00371    -2.89    .0039    -.01797    -.00344
  ASC_SM|      .49797          .34512    1.44     .1490    -.17844    1.17439
--------+-----------------------------------------------------------------
***, **, * ==> Significance at 1%, 5%, 10% level.
```

Table 16. Sub-group who said Covid influenced their purchasing.

```
--------+-----------------------------------------------------------------
        |                   Standard              Prob.      95% Confidence
   ANS_1| Coefficient       Error      z        |z|>Z*        Interval
--------+-----------------------------------------------------------------
      PP|     -.00322**        .00132    -2.43    .0151    -.00581    -.00062
   SC_HD|     -.01518***       .00382    -3.98    .0001    -.02266    -.00770
      TW|      .00269          .00398     .68     .4996    -.00512     .01049
      PR|      .00623**        .00270    2.30     .0213     .00093     .01153
      LT|     -.10512***       .02530    -4.15    .0000    -.15471    -.05552
  ASC_CP|     -.53910          .34715    -1.55    .1204   -1.21949     .14130
      TT|     -.03279***       .00771    -4.25    .0000    -.04791    -.01767
   SC_CP|     -.00124          .00521     -.24    .8123    -.01144     .00897
  ASC_SM|      .14379          .50867     .28     .7774    -.85319    1.14077
--------+-----------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
-------------------------------------------------------------------------
```

7. Policy implications

7.1 Analysis of market shares

The market shares for each of the alternatives are estimated following the MNL model. Considering the current conditions of the market from the significant multi-channel retailer (NorgesGruppen), it is possible to calculate the deterministic part of the utility of (V) for each alternative (in-store (IS), home delivery (HD), and click and pick (CP)) following the formula below:

$$V_{is} = ASC_{is} + \beta_{PP}PP_{is} + \beta_{TT}TT_{is}$$
$$V_{hd} = \beta_{PP}PP_{hd} + \beta_{SC\_hd}SC\_HD + \beta_{TW}TW_{hd} + \beta_{PR}PR_{hd} + \beta_{LT}LT_{hd}$$
$$V_{cp} = ASC_{cp} + \beta_{PP}PP_{cp} + \beta_{TT}TT_{cp} + \beta SC\ CPSC\ CP + \beta_{PR}PR_{cp} + \beta_{LT}LT_{cp}$$

The values used were determined by the conditions from NorgesGruppen:1000 NOK, which is the minimum amount spend to reduce the service cost for CP to zero. 59 NOK is the delivery fee from the three retailers that offer online shopping (MENY, SPAR, and Joker) 2 hours is the usual time window for deliveries. The travel time determined in the is 20 minutes. have the goods delivered to your door. (59 NOK)

$$V_{store} = 0.31223 - 0.00288 \times 1000 - 0.026201 \times 20 + 0.00483 \times 100\% = -2.60497$$

$$V_{hd} = -0.00288 \times 1000 - 0.01204 \times 59 + 0.00205 \times 120 + 0.00483 \times 100\% - 0.07279 \times 12 = -3.73484$$

$$V_{cp} = -0.26467 - 0.00288 \times 1000 - 0.02601 \times 20 - 0.00713 \times 0 + 0.00483 \times 100\% - 0.07279 \times 12 = -4.05535$$

7.2 Pricing and Marketing Strategies

Different social demographics presented in the sample give the opportunity for target marketing with the results. The different demographics choose according to their needs to maximize their utility, and so companies can capitalize on this to increase profitability and market share. Considering ASC_M results in income level sub-group showed that demographic with income above 48 000 NOK prefer HD whiles those below may prefer in-store. E-grocery retailers can develop low-cost offers or promotional to try and capture this

lower-income subgroup. Delivery prices can be incorporated in the product price, so there is no delivery cost when ordering. For those with higher income, the cost is not a significant determinant of purchase decisions. So e-grocery retailers can focus on high-quality products combined with on-time deliveries. High convenience for the consumers in this sub-group can be pivotal in capturing and maintaining the market share.

Another demographic subgroup to capitalize on can be male and females. The result from estimation shows that females have a strong inclination towards in-store even though the male results produce no significant difference in preference. Again e-grocery companies can personalize ads campaign to get more females to buy from them. The inconvenience of grocery stores, especially when having young kids at home, can draw more of them to the channel. Standing in long queues to pay for your grocery and the stress of carrying shopping bags via public transport or walking can be a selling point in guaranteeing a shift in the trend.

7.3 Implications on Transport and Environment

The model estimated shows that the sample has a positive attitude towards in-store shopping given no parameters are predefined. This is consistent with the shopping diary observations that reveal the preference of participants in different categories of households. Out of the sample, 34% have said they use personal vehicles for shopping, with 50% these using electric vehicles (EV) and the 50% using non-EV cars. Oslo has a relatively good public transportation system and densely located grocery stores. Many people in the sample already use the transport system or walk to buy groceries, with half of those driving using electric vehicles. Data from e-grocery retailers shows that none are currently using electric vehicles in the fleet for delivery, and their operation can be significantly adding to green-house gas (CO_2) emission. However, e-grocery retailers are willing to switch to EV vans for deliveries as trends change the market share of HD increases.

8. Conclusions

The aim of the study is to identify the potential demand for e-grocery in Norway due to the rising trend of online grocery shopping. Grocery shopping is a niche market in Norway with few key retailers. The toughest challenge they face still comes from the brick-and-mortar chains and not each other. The low discount brick-and-mortar chain has positioned itself to be the market leader in the grocery shopping market. However, results in the model estimation show the cost attributes product price and service cost negatively impact utility. This is expected, and retailers can always innovate products and services to reduce costs for consumers.

E-grocery retailers who employ the use of supply chain techniques can significantly reduce the cost of operations and subsequently cost passed onto the consumer. E-grocery can form strategic partnerships with local suppliers can ensure effective price negotiations and high-quality produce items are sourced. Reduced cost of procurement can significantly improve prices for the consumer's benefit and therefore attracting a significant market share.

The data also show that pure e-grocery retailers buy transport and distribution services from third parties. The make-or-buy decision is aimed at maximizing long-term financial outcomes for the company. They will have to evaluate if the cost-benefit of buying a transportation service as opposed to establishing one. Delivery companies offer efficiency and even flexibility that the focal company might not have the resource to do but always charge a premium price. To capture more market share with service cost, e-grocery retailers can be able to establish transportation and delivery solutions in-house, so they are solely responsible for controlling the cost.

As expected, the product range maximizes utility for the consumer; therefore, e-grocery retailers can add various categories and sections in their offer. An example is Oda offering prepacked groceries boxes with many recipes during the boom sales in earlier stages of the pandemic, as reported in section 6.

Lead time and travel time have negative impacts on utility do not want to spend a lot of time getting satisfaction. Modern facility designs to maximize picking efficiency in the warehouse can significantly reduce lead time. Mobile pick-up stations to increase flexibility and convenience in click and pick may be a factor that motivates more people to switch to the e-grocery channel.

To conclude, E-grocery will continue to increase, but it might not replace the trip to the "brick and mortar" stores soon.

8.1 Limitations and Suggestions

Generation requests for information and response rates of the questionnaire have been very low, generally attributed to the stressful effect of Covid-19. However, we suggest that further research consider other socio-economic factors when modeling the consumer channel. This study considers channel attributes.

A major limitation in conducting this study was the COVID-19 restrictions. Therefore, the number of people who answered the questionnaire could have been higher if there was the possibility of face-to-face interviews. Unfortunately, due to the COVID-19 pandemic and the current rules of social distancing and gatherings must be followed.

A challenge to administer the stated preference questionnaire online was identifying a platform dynamic enough to alter the choice tasks according to what is being stated by the respondents in the pre-interview. A lot of time was spent researching the capability to administer the choice task online in a very convenient way for the respondent.

We suggest the investigation is carried out again but with a much larger sample. The study could also be performed in different countries to have a comparative study because consumer preferences may differ in other countries.

Glossary

- Alternatives: An alternative aim to offer a choice among two or more things. In this particular case we considered three alternatives: home delivery, click & pick and the traditional option: in-store.

- Attributes: Anything that can be associated to an individual, objects, group, etc. In our study we identified six grocery shopping characteristics (i.e., purchase price, travel time, product range, service cost and time window)

- COVID-19: The WHO defines it as an infectious disease caused by a newly discovered coronavirus.

- E-commerce: E-commerce can be described as selling products or services over the internet across geopolitical borders from a company's country of origin

- E-grocery: The term refers to the supermarkets that sell groceries through an internet platform.

- Experimental design: is way of manipulating attributes and their levels to permit rigorous testing of certain hypotheses of interest.

- Omnichannel: A unified approach that manages channels as intermingled touch points to allow consumers to have a seamless experience within an ecosystem.

- Survey: Any form of data collection involving the elicitation of preferences or choices from samples of respondents.

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Appendix 1: Stated preference questionnaire (English version)

1.- Grocery Shopping

0 %

Grocery shopping in Oslo

Next page

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1.- Grocery Shopping

8 %

Thank you in advance for your participation.
This survey seeks to learn more about e-grocery demand in Oslo and the effect of COVID-19 on it. Responses will remain anonymous and be used for research purposes only.
Time: 6mins max!!

Do you live in Oslo? *

○ Yes   ○ No

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1. Have you ever purchased goods online? (Amazon, Komplett, Zalando, flight tickets...) *

○ Yes

○ No

2. Are you aware of the possibility of buying groceries online in Oslo? *

○ Yes

○ No

3. Have you ever purchased groceries online? *

○ Yes

○ No

4. Where do you usually shop for your groceries? *

○ Convenience stores (7-Eleven, Narvesen, Joker)

○ Supermarket (Rema 1000, KIWI, MENY...)

○ Hypermarket (Coop Obs)

○ Online

○ Other

5. Which transportation mode do you usually use for shopping? *

○ Personal Car

○ Public Transport (T-bane, Bus, Trikk)

○ Walking

○ Other

5. a) Select your type of car: *

○ Petrol

○ Diesel

○ Electric

6. Do you usually perform dedicated trips to do the shopping? *

A dedicated trip is a planned journey to go to the store

○ Yes

○ No

7. How much would you be willing to pay to avoid this trip? *

(delivery cost in NOK)

8. How many times do you buy groceries with In Store Option (per week)? *

In-store means buying grocery in the physical supermarket

9. How many times do you buy groceries with Home Delivery Option (per week)? *

Home Delivery means buying groceries online and having them delivered to your house

[   ]

10. How many times do you buy groceries with Click & Pick Option (per week)? *

Click & Pick means buying groceries online and picking them up at the store

[   ]

11. On what days do you usually do grocery shopping? *

○ Monday - Friday

○ Saturday

12. Has the COVID-19 pandemic influenced the way you purchase groceries? *

○ Yes   ○ No

12. a) Why? / How?

Explain your answer

[   ]

13. Are there any changes with respect to the channel you use to purchase groceries now? *

(Frequency, change of channel, etc ...)

[   ]

14. Do you feel safer to shop groceries online rather than going to the store during this COVID-19 pandemic? *

○ Yes

○ No

15. How long does it take you to reach your shopping place (round trip in minutes)? *

[Select ...   ▾]

16. How much on average do you spend on groceries per purchase? *

(in NOK)

[Select ...   ▾]

[Previous page]   [Next page]

In the following sections, we will present 6 different scenarios based on your previous answers, please select the best for you:

Definitions:

- **Purchase cost:** How much you spend for buying the same product.
- **Service cost:** Additional cost to get the goods delivered at the desired place.
- **Preparation time of the order:** Time between placing orders and the order is ready to be sent.
- **Time window:** Expected time of arrival range. E.g.deliver between 12-14 today.
- **Range of available products:** Percentage of available products online with respect to regular shop.
- **Travel Time:** The time you need to travel to stores and back (Do not include shopping).

Scenario #1

	HOME DELIVERY	CLICK AND PICK	IN STORE
Purchase cost [NOK]	100	100	100
Service cost [NOK]	100	0	
Preparation time of the order [hour]	6	1	
Time window [minutes]	60		
Range of available products [%]	50	100	100
Travel Time[minutes]		10	20

Which one will you choose? *

○ Home delivery

○ Click and pick

○ In-store

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Scenario #2

	HOME DELIVERY	CLICK AND PICK	IN STORE
Purchase cost [NOK]	100	100	100
Service cost [NOK]	100	0	
Preparation time of the order [hour]	6	1	
Time window [minutes]	120		
Range of available products [%]	100	100	100
Travel Time[minutes]		20	20

Which one will you choose? *

○ Home delivery

○ Click and pick

○ In-store

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Definitions:

- **Purchase cost:** How much you spend for buying the same product.
- **Service cost:** Additional cost to get the goods delivered at the desired place.
- **Preparation time of the order:** Time between placing orders and the order is ready to be sent.
- **Time window:** Expected time of arrival range. E.g.deliver between 12-14 today.
- **Range of available products:** Percentage of available products online with respect to regular shop.
- **Travel Time:** The time you need to travel to stores and back (Do not include shopping).

Scenario #3

	HOME DELIVERY	CLICK AND PICK	IN STORE
Purchase cost [NOK]	90	110	100
Service cost [NOK]	0	50	
Preparation time of the order [hour]	1	12	
Time window [minutes]	60		
Range of available products [%]	150	50	100
Travel Time[minutes]		15	20

Which one will you choose?

○ Home delivery

○ Click and pick

○ In-store

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Responsible for the form: **tania.c.rodriguez.montero@stud.himolde.no**.

Definitions:

- **Purchase cost:** How much you spend for buying the same product.
- **Service cost:** Additional cost to get the goods delivered at the desired place.
- **Preparation time of the order:** Time between placing orders and the order is ready to be sent.
- **Time window:** Expected time of arrival range. E.g.deliver between 12-14 today.
- **Range of available products:** Percentage of available products online with respect to regular shop.
- **Travel Time:** The time you need to travel to stores and back (Do not include shopping).

Scenario #4

	HOME DELIVERY	CLICK AND PICK	IN STORE
Purchase cost [NOK]	100	110	100
Service cost [NOK]	0	50	
Preparation time of the order [hour]	1	12	
Time window [minutes]	30		
Range of available products [%]	150	50	100
Travel Time[minutes]		15	20

Which one will you choose? *

○ Home delivery

○ Click and pick

○ In-store

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Responsible for the form: **tania.c.rodriguez.montero@stud.himolde.no**.

Definitions:

- **Purchase cost:** How much you spend for buying the same product.
- **Service cost:** Additional cost to get the goods delivered at the desired place.
- **Preparation time of the order:** Time between placing orders and the order is ready to be sent.
- **Time window:** Expected time of arrival range. E.g.deliver between 12-14 today.
- **Range of available products:** Percentage of available products online with respect to regular shop.
- **Travel Time:** The time you need to travel to stores and back (Do not include shopping).

Scenario #5

	HOME DELIVERY	CLICK AND PICK	IN STORE
Purchase cost [NOK]	110	100	100
Service cost [NOK]	100	0	
Preparation time of the order [hour]	1	6	
Time window [minutes]	60		
Range of available products [%]	100	150	100
Travel Time[minutes]		10	20

Which one will you choose? *

○ Home delivery

○ Click and pick

○ In-store

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Definitions:

- **Purchase cost:** How much you spend for buying the same product.
- **Service cost:** Additional cost to get the goods delivered at the desired place.
- **Preparation time of the order:** Time between placing orders and the order is ready to be sent.
- **Time window:** Expected time of arrival range. E.g.deliver between 12-14 today.
- **Range of available products:** Percentage of available products online with respect to regular shop.
- **Travel Time:** The time you need to travel to stores and back (Do not include shopping).

Scenario #6

	HOME DELIVERY	CLICK AND PICK	IN STORE
Purchase cost [NOK]	100	90	100
Service cost [NOK]	50	0	
Preparation time of the order [hour]	12	12	
Time window [minutes]	120		
Range of available products [%]	50	100	100
Travel Time[minutes]		20	20

Which one will you choose? *

○ Home delivery

○ Click and pick

○ In-store

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Post Interview

Imagine now that an online shopping service is available that meets your needs perfectly. How much would this change your current behavior?

How many times would you buy groceries in store (per week)? *

How many times would you buy groceries with home delivery option (per week)? *

How many times would you buy groceries with click & pick option (per week)? *

Should scientific reports demonstrate shopping groceries online reduces CO2 emissions, would you be willing to do so more frequently? *

○ Yes

○ No

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Responsible for the form: **tania.c.rodriguez.montero@stud.himolde.no**.

83 %

Socio-demographic and attitudinal variables

Gender

○ Female

○ Male

Age

○ 18-24

○ 25-34

○ 35-44

○ 45-54

○ 55-64

○ More than 65

How many family members do you live with?

- ○ None
- ○ 1
- ○ 2
- ○ 3
- ○ More than 3

What is your household monthly budget in general?
(optional)

- ○ Less than 7500 NOK
- ○ 7500-21000 NOK
- ○ 21000-34500 NOK
- ○ 34500-48000 NOK
- ○ 48000-61500 NOK
- ○ 61500-75000 NOK
- ○ More than 75000 NOK

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92 %
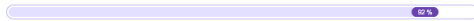
Thank you for taking the time to complete this survey. We truly value the information you have provided.

If you want to take part in a prize draw, please leave your email address:

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Appendix 2: Shopping diary (English version)

Shopping Diary

`0 %`

Mandatory fields are marked with this star *

Survey:

Shopping diary

[Next page]

Shopping Diary

`50 %`

Mandatory fields are marked with this star *

Based on your most recent grocery shopping, please answer the following questions:

e-mail *

[_____]

1. How did you buy your groceries? *

- ○ In-store shopping
- ○ Online with Home Delivery
- ○ Online with Click and Pick

2. When did you buy your groceries? *

[DD.MM.YYYY 📅]

3. Select your type of trip: *

Dedicated trip= You planned a trip to the supermarket

Non-dedicated trip= You did not initially plan on going to the supermarket

○ Dedicated

○ Non-dedicated

4. What time did you start? *

The time you start shopping at the supermarket (in-store / website)

`hh:mm`

5. What time did you finish? *

The time you finish shopping at the supermarket (in-store / website)

`hh:mm`

6. What main transport mode did you use? *

○ Walking

○ Bike

○ Personal Car

○ Bus

○ T-bane

○ Other

6.1. Type of car:

○ Petrol

○ Electric

○ Diesel

7. What is the distance from your house to the store? *

○ Under 1 km

○ 1 - 2 km

○ 3 - 5 km

○ 6 - 10 km

○ More than 10 km

8. How much did you pay for the groceries?

○ Less than 300 NOK

○ Between 301- 500 NOK

○ Between 501- 700 NOK

○ Between 701- 900 NOK

○ Between 901- 3000 NOK

○ More than 3001 NOK

9. What are the products you bought?

You can select more than one answer

- ☐ Bread, flour and bakery products
- ☐ Meat and seafood
- ☐ Fruit and vegetables
- ☐ Eggs, milk and cheese
- ☐ Sugar, chocolate and confectionery
- ☐ Waters, beverages and spirits
- ☐ Pets supply
- ☐ Hygiene, paper and beauty
- ☐ Baby supply
- ☐ Detergents and household cleaning
- ☐ Other

10. Number of bags:

- ○ 1
- ○ 2-3
- ○ 4-5
- ○ More than 5

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The form contains questions that can be personally identifying. **Show more ▾**

Shopping Diary

Thank you for taking the time to complete this survey. We truly value the information you have provided.

✉ Do you want a receipt by email?

Appendix 3: Company interview guideline

1. Can you briefly describe your position and what you do in the company?
2. Could please describe the main characteristics of logistics solutions that your company employs?
3. How has COVID-19 affected the logistics and transport operation?
4. Does the company use 3rd party for transportation?
5. What is the transport fleet size and vehicle types?
6. Do you consolidate the freight and what factors influences this?
7. What are the kilometers driven per delivery trip?
8. What is the average number of deliveries made per trip?
9. What challenges do you face in the e-grocery market?
10. What do you think is the future for e-grocery shopping in Norway?

Apprendix 4: Survey Poster