Master's degree thesis

LOG950 Logistics

Investigating the potential demand for E-grocery shopping in Norway

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Preface

This MSc thesis is written as a completion of the master degree program in logistics, specialized in supply chain management at Molde University College. First of all, we would like to express our deepest gratitude to our supervisor, Professor Edoardo Marcucci, for all his guidance and support throughout the writing of this master thesis. Professor Valerio Gatta also provided us great help with experimental design and regression analysis.

Furthermore, we would like to thank all the interviewees of this study, who provided valuable information and data about the topic. We appreciate their time and patience. This master thesis could not be performed without their participation.

Finally, we would like to thank our friends in both universities and our families for their support during our studies.

Abstract

In the ICT age, E-grocery shopping becomes an increasing trend and affects consumers and retailers globally. Facing this trend, it is important to make predictions in advance and adapt to the environment. In Norway, the popularity of E-grocery is growing but it is still a niche market. With the positive predictions, the E-grocery retailers in Norway are facing various challenges. Moreover, little to no prior research has been done to investigate the demand side of Norwegian E-grocery. Therefore, it is important to fill the research gap and provide information on consumers behaviour and their channel choices towards grocery shopping in Norway.

The aim of this paper is to investigate Norwegian consumers' potential demand for E-grocery shopping, as well as the implications on grocery retailing and transportation. In this paper, in-depth interviews and focus group are performed as supportive studies. 202 interviews are collected by using a purposely developed questionnaire. This research explores, though a stated preference experiment, that product price, service cost, lead time, time window, travel time and product range are the attributes that affect most consumers channel choices. All the attributes except product range have negative impacts on consumers utility level.

Based on the econometric results, different types of willingness to pay are calculated and compared within different subgroups. The multinomial logit models are estimated to simulate market shares. The result demonstrates that, with the current market condition, in store shopping still has the dominant market share. However, if no other market condition is specified, home delivery is the most preferred grocery purchasing mode.

Given the preference structure of the sampled households, several scenario simulations are conducted. Based on the results, the study offers some realistic suggestions on managerial policies that could potentially increase the E-grocery market share, such as price strategy, marketing strategy and warehouse location strategy. Moreover, implications on urban freight transportation public policies are discussed. This paper contributes to both the academic environment and grocery retailing industry by providing a quantified evidence of the growing trend of E-grocery, as well as a detailed database on Norwegian consumer behaviour in grocery shopping.

Contents

List of tables

List of figures

1. Introduction

1.1 Motivation for the thesis

With the development of information and communication technologies (ICT), the way consumers purchase products has changed dramatically. In the ICT age, as an important innovation, the internet introduces a new alternative shopping channel to free consumers from traveling to traditional physical stores. The new mode changes consumers' lives and causes more complicated consumer purchasing behaviour. The new shopping mode has been described using different expressions such as: e-shopping, online shopping, web-based shopping, internet-based shopping and online retail (Mokhtarian, 2004).

Globally, e-commerce is becoming mature and popular. The online retail sales are predicted to grow continuously from 2014 to 2021 (see Figure 1-1) (International Post Corporation, 2017). In 2017, e-commerce sales worldwide reached US$2.3 trillion with 1.66 billion people shopping online. China and America account for 70% of total e-commerce revenue, according to the International Post Corporation (2017). At the end of 2021, the total e-commerce transactions globally are predicted to increase 141% compared with 2016. However, the change varies by regions. The market of e-commerce in European countries develop quite slowly with the sales of US$337 billion in 2017 (International Post Corporation, 2017). Eastern Europe is even slower than the Western. UK is the leader in e-commerce market in Europe followed by Germany and France. The e-commerce sales growth rate in Nordic countries are slow as well, and the online sales account for 10% of the total retail sales in 2017 (International Post Corporation, 2017).

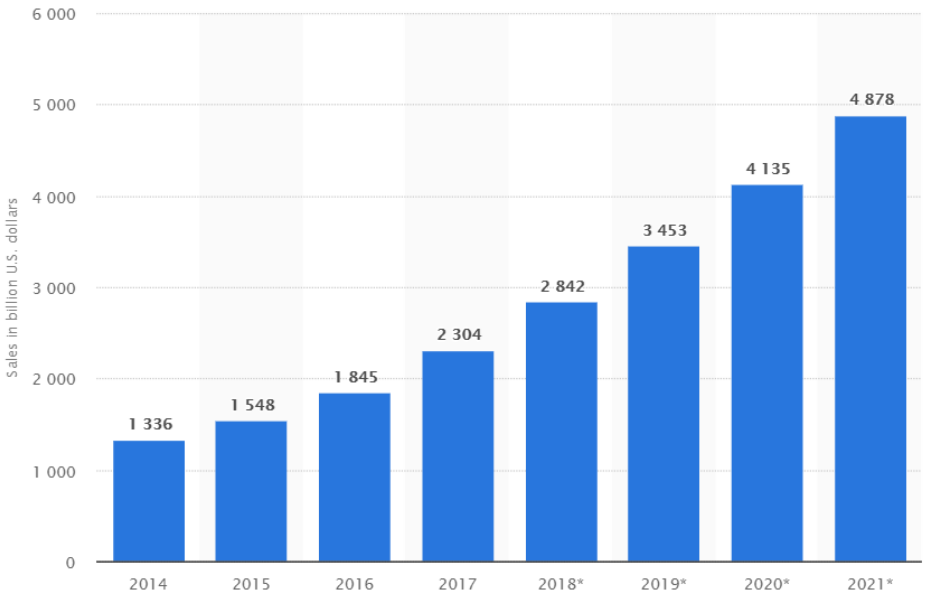

Figure 1-1. E-commerce sales from 2014-2021 worldwide

Source: (International Post Corporation, 2017)

According to a survey on popularity of E-commerce carried out by Postnord, Norway has ranked as the second place among the Nordic countries. 65% of Norwegian residence aging between 18 to 19 years old have purchased goods online, while this ratio is 67% in Sweden (Postnord, 2016). The most frequently bought goods online in Nordic countries are clothing, footwear, media and home electronics. The usage of online shopping varies by product types. Compared with other retail sectors, grocery occupies a very small market in Nordic countries (Postnord, 2016). It generates the interest of this paper to investigate why grocery market for e-commerce are smaller than others, and what are consumers' channel preferences towards grocery shopping.

Although E-grocery market size is about only 5% in 2016 compared with total e-commerce market in Norway, many researchers predict that E-grocery will keep growing in the future (Postnord, 2016). A research carried out by Larsen and Klyve claims that E-grocery will keep growing in the next years. More actors will enter the market offering better and cheaper E-grocery solutions (Klyve & Larsen, 2017). Nielsen shows that there are 11.6 percent of Norwegian consumers have shopped grocery online in 2017. This number has doubled since 2016 (Nielsen, 2017). Another report from Virke states that among all the grocery sales channels in Norway, online grocery channel had the biggest growth since 2016 (Virke Enterprise Federation, 2017).

On the contrary, with the positive predictions, E-grocery retailers are facing challenges in Norway. Dreyer & Bakås (2017) claim that multi-channel retailers in Norway have low profitability and high risk. In fact, 123levert company has announced bankrupt in 2017 (Solem, 2017). In the same year, the biggest online grocery store in Norway, Kolonial, has also laid off 100 employees due to hard competitions (Solem, 2017). The contrast between growing popularity of E-grocery and the undesirable performance of E-grocery retailers in Norway again forms the need to inquire into Norwegian consumers' potential demand for E-grocery, and how E-grocery market share will change.

Moreover, as an essential for human, purchasing grocery is the most common and frequent shopping activity, which has close relationship with transportation (Suel & Polak, 2017). E-grocery will impact consumers' shopping trips, as well as freight movement from distribution centre to consumers. Therefore, the effects on transportation resulting from E-grocery shopping in Norway will be discussed in this paper.

There are few studies evaluating the demand side of E-grocery in Norway. The reason might be the heterogeneous activities related for shopping itself, the complication of consumer behaviour towards e-commerce, or the difficulty of collecting data in the unmatured market (Rotem-Mindali & Salomon, 2007). A research funded by Research Council of Norway is to investigate existing business models and planning environment in Norway for online food business (NTNU, 2018). Another study conducted by Dreyer and Bakås (2016) pays more attention on the supply side, developing an analytical framework that combined business model and planning perspectives. However, understanding consumers' demand is essential for supply chain planning and transportation implications.

In a brief, this research aims to fill the research gap on demand side for E-grocery market in Norway. The paper intends motivated by the contrast between growing popularity of E-grocery market and challenging environment facing by the retailers. The objective is to investigate Norwegian consumers' potential demand for E-grocery and how the market share will change in the future.

Shopping is a process consisting a sequence of different actions instead of a monolithic activity (Peterson, et al., 1997). The emergence of the Internet breaks traditional sequences and recombines the process in a new way in terms of time and space (Couclelis, 2000). For instance, people do not need a specific time window to buy grocery in store. They can purchase products

online when they are on the bus going to party with friends. The recombined shopping process changes consumers behaviour and generates impacts on transportation.

The transportation impacts caused by ICT are complicated. According to Mokhtarian (2004), there are mainly 4 different causes: 1. changes of shopping mode share (with fixed purchasing volume), 2. changes in the shopping products volume (with fixed spending), 3. changes of consumption spending (without demographic changes), 4. demographic changes. Due to the time limitation, it is not practical to evaluate all of them in this paper. Obviously, those potential elements will generate different influences simultaneously on the transportation. Some increases travels, some reduce travels (Mokhtarian, 2004). Having better understanding on different causes can avoid excessive assessment or ignore other resources impacts on the results. This article will only focus on the transportation impacts of shopping mode share (online and in store) in Norwegian E-grocery market.

Shifting shopping mode from store to online will generate both positive and negative impacts on transportation. When consumers purchase online, the delivering travels are passed from consumer side to the supplier side. The impacts are uncertain which depend on the type of product, shopping frequency, the purpose of shopping activities, trip chaining with other activities, and the trade-off between efficiency and time constraints (Mokhtarian, 2004). For instance, if the purpose of consumers go to store is for movement or social entertainment, or the trip is not dedicated, then the online shopping cannot save any travel trips (Williams & Tagami, 2002). Moreover, the online shopping will bring disbenefit to people due to the reducing of exercise or entertainment (Keskinen, et al., 2001). More discussion about transportation impacts of the changes on shopping mode share will be shown in the section 8.

1.2 Research problem and questions

The research problem of this thesis is **to investigate Norwegian consumers' potential demand for E-grocery shopping, and the implications on transportation.**

For solving the main research problem, the following three research questions need to be answered sequentially.

Research question 1. What are the factors affecting consumer preferences towards online and offline grocery shopping channels? How these factors influence consumers choices?

In order to investigate consumers' potential demand for E-grocery shopping, the first step is to find out what factors will influence consumers grocery shopping channel choice. After identifying the key attributes, the consumer preferences (utility function) will be set up through stated preference choice modelling. For Norwegian consumers, E-grocery is newly sprouted with a slow growth rate. The research assumes that, in the absence of sufficient empirical evidence, stated preference method could be more helpful to collect and analyse data. Next, the research will investigate how the key factors influence consumers choice through the calculation of willingness to pay.

Research question 2. How the E-grocery market share will change in Norway?

In 2016, the market share of E-grocery is around 5% with respect to the total e-commerce market in Norway, accounting for 0,1% of total grocery turnover. Through discrete choice modelling, it is possible to find out the current market share and assess how the market share can change regarding different marketing conditions in the future. Consumers' potential demand can bring changes to E-grocery's market share in terms of gross market size and market share proportion between different channels.

Research question 3. What are the implications regarding the potential demand of E-grocery?

E-grocery could possibly substitute consumers grocery shopping trip. Additionally, with E-grocery, last mile delivery is shifted from consumer side to retailer side. Consumers' potential demand for E-grocery shopping could generate noteworthy impacts on both passenger and freight transportation. At the same time, the relative challenges will gradually become obvious for both retailers and policy makers, such as the difficulty in home delivery and CO_2 emission problems. Effect on different policy scenarios will be simulated in order to discuss the possible policy implications.

1.3 Structure of the thesis

In terms of structure for this paper, the next section presents a brief review of previous works about the impacts of the Internet on grocery retailing, transportation and consumer channel choices. Moreover, a literature review about relevant theories as a foundation to decide the methodology and investigate focused problem is included in this section as well. The third section illustrates a discussion of methodology which shows a framework of conducting stated preference method as a main fashion to collect and analyse data. The fourth section provides a

general and holistic view of the current situation for Norwegian grocery market. The following two sections are questionnaire description and data description. The econometric results and main findings are evaluated in the section seven. Besides, the paper outlines policy implications on transportation and managerial implication for E-grocery in the future in section eight. Finally, the last section concludes the main results by answering three questions and presents limitations for the paper.

2. Literature review

2.1 Introduction

A literature review is a way to locate and to summarize the studies about a topic (Creswell, 2014). In this study, the literature review is used in order to investigate the knowledge frontier on E-grocery topic, as well as to provide a context for the research and justify the research.

To minimize research arbitrariness, key words for literature research are carefully defined. The preliminary key words selected for literature research include: “Online grocery”, “E-grocery”, “Multi channel grocery”, “Online grocery consumer choice”, and “Grocery channel choice”. To ensure a high scientific content level of the papers, ScienceDirect is predominantly used as database for this literature research. Key word “online grocery” produces 5195 results, “E-grocery” produces 12404 results, “Multi channel grocery” produces 1956 results, and “Grocery channel choice” produces 2489 results.

Given the heterogeneity and the excessive amount of results obtained, a strategy of refinement is needed. In this research, the scope of study is limited by years of punishment (i.e. from 2000 to 2018), document types (i.e. research paper), and research areas (i.e. marketing, retailing, logistic, transportation).

There are a large variety of research objective and methodologies on the topic of E-grocery. According to the relevance to our research, this literature review will have deep examination of ICT’s impact on consumers and grocery retailing, as well as the transportation impacts of E-commerce. Additionally, this literature review will discuss about previous studies on consumer channel choice, and then give an evaluation on the stated preference and revealed preference methods. Moreover, the relevant theories with supported models will be reviewed and discussed as a foundation to investigate problem and questions. The structure of literature review is

illustrated in Figure 2-1.

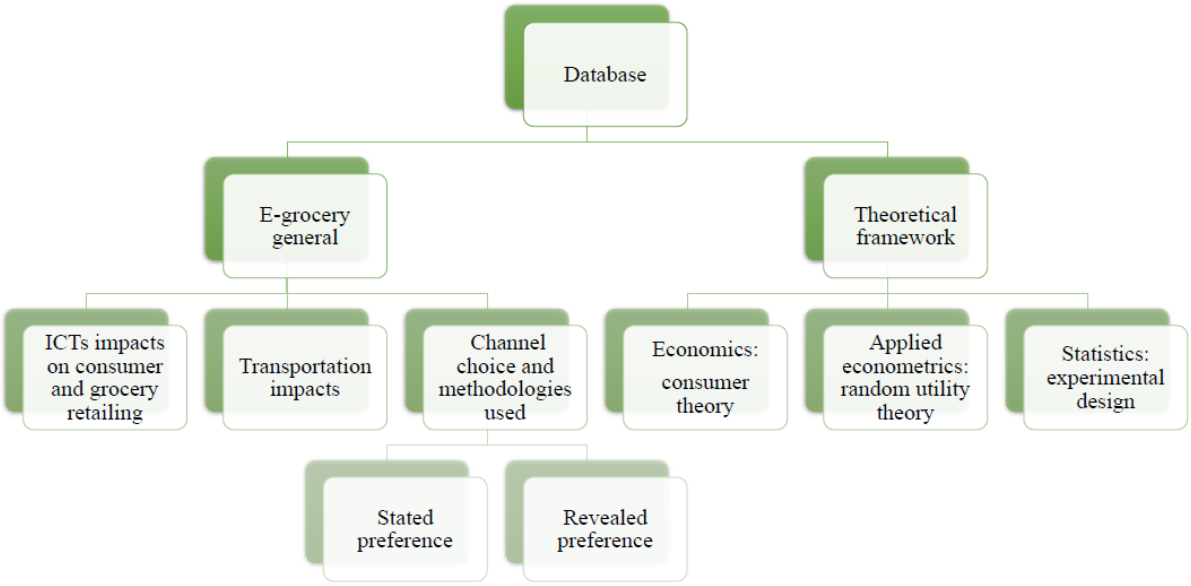

Figure 2-1. The structure of literature review

2.2 Impacts of ICT on consumers and grocery retailing

ICT has impacts on both consumers and grocery retailers. In order to investigate how consumers' channel choice can be influenced, one needs to understand the processes and characteristics associated with shopping. Moreover, ICT can restructure grocery retailing. Hence the grocery market share will be changed. Previous studies regarding the impacts of ICT on consumers shopping behaviour and grocery retailing are presented in this part.

2.2.1 ICT's impacts on consumers behaviour

In order to study what drives consumers channel choice, one needs to understand how consumers shopping behaviour are influenced by ICT. Typical consumer behaviour literatures present shopping as a process. Mokhtarian (2004) mentions that typical elements of shopping process include "*desire, information gathering/receiving, trial/experience, evaluation, transaction, delivery/possession, display/use and return.*" (Mokhtarian, 2004, p. 264) For traditional grocery shopping, the process of experience, evaluation, transaction and delivery are usually happening in the store at the same time and same place. However, Couclelis (2000) puts forward that ICT has fragmented the previously holistic shopping processes, and reconstructed them in new ways. It can change the time and space information of activities. The new grocery

shopping channel based on the Internet transforms consumers purchasing behaviour. People do not need to allocate a specific time in a specific place to purchase grocery. They could collect information and compare prices easily through the Internet. Travel time could be saved to perform other activities. Therefore, different activities of purchasing grocery in different phases could be accomplished in different time and places now (Munson, et al., 2017). As such, consumers face more risk to purchase grocery online due to the constraints on experience process (Munson, et al., 2017). Nevertheless, once consumers gain more experience on E-grocery, other choice determinant become more important, such as price, product range, lead time (Elms, et al., 2016).

The influences of ITC on shopping process varies among different products. Empirical marketing studies have categorized goods into two types: search goods and experiences goods. Nelson (1970) distinguishes the search and experienced goods by the extent to which consumers can evaluate goods and their attributes prior to purchasing. However, Weathers et al. (2007) mention that the information gathering process could be carried out through different channels. Therefore, search goods through one channel could be experienced goods through another channel. For example, when a consumer tries a pair of shoes in a store, the shoes are experienced goods in store channel. After information and experiences about the shoes are obtained, the consumer can choose to purchase the shoes online. The shoes thus became search goods in online channel (Weathers, et al., 2007). Due to the low risk linked to substituting search goods by e-shopping, it is claimed that pre-purchase and purchase activities at stores may decline while shopping travel distance increases. Nevertheless, pre-phase and purchase activities for experienced goods at stores may not show the same trend (Bloch & Richins, 1983).

Grocery contains both search goods (e.g. beer, toilet paper, canned food), and experienced goods (e.g. fresh fruit and vegetables). When considering consumers channel choice, various grocery types might have different influences on consumers choices. In this paper, it is assumed that experienced goods constitute the main type of products in the typical shopping grocery basket, and the assumption will be tested in the SP questionnaire.

2.2.2 Norwegian consumers behaviour in grocery shopping

In 2016, the annual expense on groceries for Norwegian households are 1 336 billion (SSB, 2016). Averagely, Norwegian consumers spend around 12% of their total monthly budget on food. A typical Norwegian family with two parents and two children spends 8149 kroner on

food and drink per month (SSB, 2016).

Store location and price drive consumers' choice of grocery stores. Norway has the highest grocery store density in Europe with respect to population. In 2016 there are a total number of 3814 stores in Norway (Nielsen, 2017). This gives 7.5 stores per 10 000 residents, while in Sweden, there are 4 stores per 10 000 residents. The stores have become both fewer and bigger, and the opening hour has become longer. Therefore, it is claimed that the high store density makes Norwegian consumer disloyal to a specific store. Their choices are mainly driven by locations and prices (Virke Enterprise Federation, 2017).

Averagely, a Norwegian household carries out 3.5 grocery trips per week. A market survey in 2016 showed that 3 out of 4 Norwegian households shop groceries multiple times per week, and 7% Norwegian households shop groceries every day. Figure 2-2 summarises the frequency of grocery shopping for Norwegian households. 46% Norwegian consumers shop groceries in different stores during the weekdays and on weekends. While 54% consumers choose to shop groceries in the same store both on weekdays and weekends (Norwegian Consumer Council, 2017). On weekdays, consumers are more concerned with shops location, parking availability and prices. For weekend grocery shopping, it is important for Norwegian consumers that stores have good assortment, high quality of goods and are within reasonable travel distance (Norwegian Consumer Council, 2017).

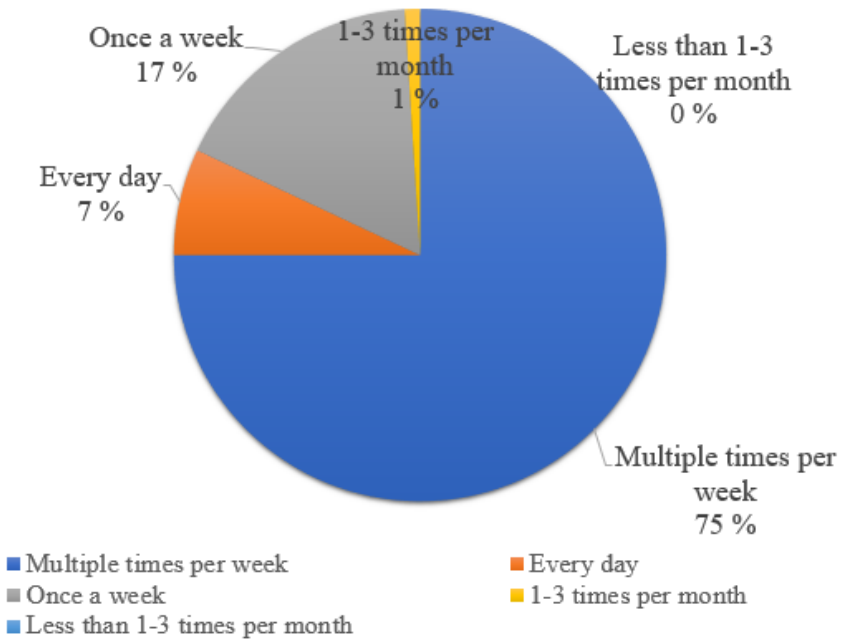

Figure 2-2. Frequency of Norwegian households' grocery shopping

Source: (Norwegian Consumer Council, 2017)

When it comes to E-grocery, a report of Norwegian consumer council show that the majority of Norwegian consumers prefers in-store shopping. They like to see and feel the quality of the goods. Some consider going to grocery shops as a social activity. High delivery cost hinders consumers' choice for E-grocery. However, the trend of E-grocery retailing is growing (Norwegian Consumer Council, 2017).

The turnover of Norwegian online grocery retailing in 2016 was 2.1 billion, which has grown 40% since 2015 (Norwegian Consumer Council, 2017). Consumers purchasing grocery online are typically within the age range from 30 to 44 years old. There is significant geographic variation. For example, statistics shows in Oslo 15% of residents have purchased groceries online while this percentage is much lower in cities with less population density (Norwegian Consumer Council, 2017). In terms of online grocery shopping frequency, over half part online grocery consumers use online grocery channel less than once a month. Currently, online grocery only accounts for a marginal part of Norwegian households' grocery purchase. A market survey in 2016 demonstrates that, among the E-grocery users, only 16% of them purchase grocery through E-channel more than in-store channel. 65% E-grocery users only purchase 10% of their monthly grocery through online channel. Figure 2-3 summarises E-grocery users' frequency of purchasing groceries online.

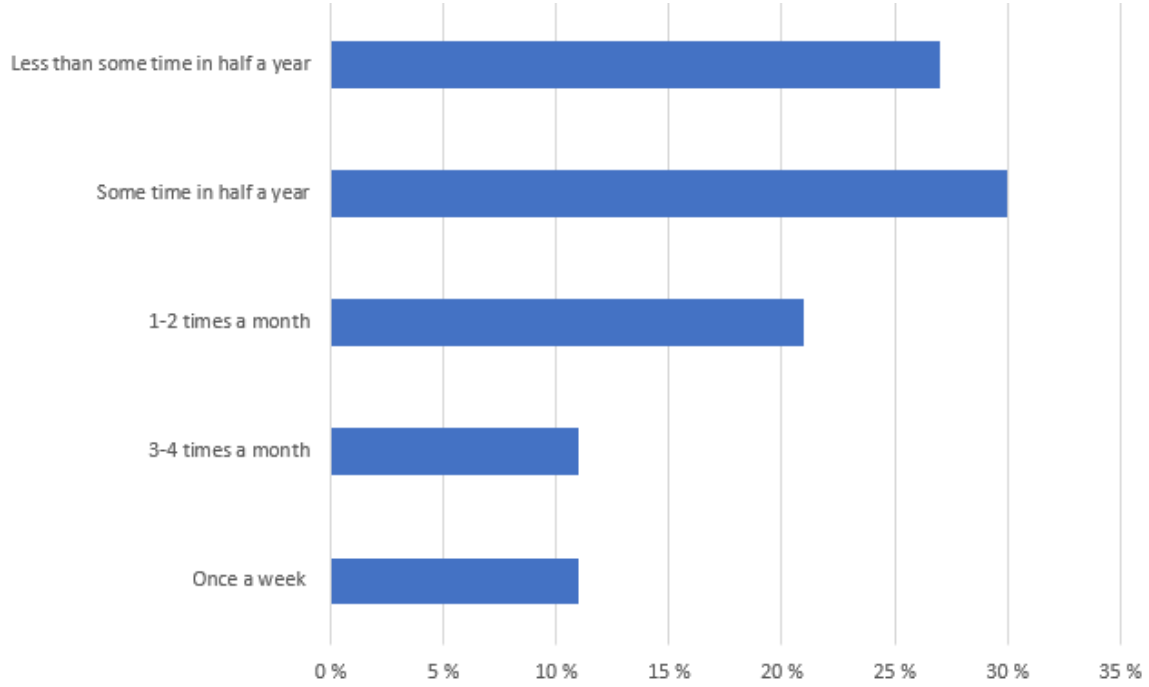

Figure 2-3. E-grocery users' frequency of purchasing groceries online

Source: (Norwegian Consumer Council, 2017)

There are different drivers for those who purchase groceries online. From an interview with 68 participants in 2016, it is discovered that the most important reasons are convenience and time saving. Consumers avoid the dedicated store trip by using online grocery channel, and thus avoid the queue (Norwegian Consumer Council, 2017). There are other reasons for consumers to choose online grocery. It is easier to plan grocery, and the consumers can purchase large amount at once. Moreover, by the use of online grocery shopping the consumers can avoid impulsive shopping (Norwegian Consumer Council, 2017) (Hensher, et al., 2005).

2.2.3 The Internet and grocery retailers

The Norwegian online grocery market share accounts for 5% percent of the E-commerce market. The newly sprout E-grocery market brings business opportunities as well as challenges for the grocery retailers. In order to investigate how E-grocery market share will change in the near future, the way internet transforms grocery retailing needs to be reviewed. Grocery products are mostly perishable and have high variety. Also, the frequency of grocery shopping is generally considered higher than other shopping activities. Therefore, E-grocery shopping differs from general E-shopping (Mortimer, et al., 2016). With the proliferation of ICT, grocery retailing was considered likely to benefit from the "death of distance" (Elms, et al., 2016). Unlike other types of merchandize such as CD, books or tickets, groceries are less readily to be reformed by introducing of new internet channel. This is due to complexity in grocery logistics associated with online channel retailing (Murphy, 2003). Some types of grocery have special temperature or storage requirement. Consumers are generally concerned about the groceries' freshness. Murphy (2003) emphasizes that time and space issues are the core issues of online grocery retailing. Particularly, many online grocery retailers struggle with cost and logistic problems. Murphy (2003) suggests that store-based operations can be suitable for short-term profitability, while warehouse-based pure online players can hold sustainability with respect to efficiency and flexibility.

Internet introduces a new channel of grocery retailing. Hence the grocery market share will be changed. The E-grocery retailing market is mainly shared by pure internet actors and multi-channel retailers. In many retailing markets, the pure online players have gone through rapid growth. In Norway, the omni-channel grocery retailers were under the argument of low profitability and high risk for the online services, yet the size of internet service is still increasing (Dreyer & Bakås, 2017) (Larsen & Klyve, 2017). The assertion is that E-grocery market will keep growing. Nevertheless, it is emphasized that online grocery will not replace

traditional grocery shop. Consumers tend to use online channel as a supplement way for purchasing grocery and will continue purchase groceries from stores (Elms, et al., 2016) (Couclelis, 2006).

In short, previous studies illustrate that unlike other types of merchandise, grocery retailing is less readily to be changed by the new channel. It is anticipated that the market share of E-grocery will grow, however they will not replace traditional grocery stores.

2.3 The transportation impacts of e-shopping

Mokhtarian (1997) summarizes four main types of conceptual relationships between transportation and ICTs: substitution, complementarity, modification, and neutrality (Mokhtarian, 1997). The relationships will affect both consumers' shopping trips as well as the freight distribution. In order to investigate possible transportation implication regarding consumers' growing demand for E-grocery, previous studies on E-shopping transportation impacts will be discussed in this part.

2.3.1 Impacts on individual shopping trips

Mokhtarian (2004) mentions the initial assumption is that e-shopping substitutes in-store shopping. Theoretically, consumers shopping trips will be reduced. However, this assumption is based on the presumption that consumers make dedicated trips to the store. In many cases, shopping trips are chained with other activities, hence the incremented distance added by shopping trips is negligible. Moreover, shopping trips can be made by walking, cycling, or public transportation. In these cases, reducing the shopping trips will not benefit the congestion, emission, or energy consumption (Mokhtarian, 2004).

A study carried out by Casas et al. in 2001 analyses the impacts of internet shopping on the frequency of in-store shopping trips. The result shows that in general, internet shoppers make more trips. Consumers' income and age have positive association with shopping trip rates. According to Casas et al. (2001), e-shopping is mainly used as complementary shopping and does not substantially reduce consumers' shopping trips to stores.

A Similar conclusion is drawn in a German simulation study of travel reduction through online shopping. In this study, Luley, et al. (2002) mention that overall, as e-shopping increases, more rather than less traffic is expected. Nevertheless, a light substitution of e-shopping is expected

in the trip frequency. A positive association between online products information search and store shopping frequency is concluded by Cao et al. in 2010. Consumers tend to make a special trip to the stores because of something they saw online (Cao, et al., 2010). Farag, et al. (2002) suggest that if e-grocery substitutes for grocery shopping trips, one can expect reduction of car trip in less urbanized areas, and reduction of walking and bike trips in more urbanized areas.

2.3.2 Impacts on freight logistics

Consumers shopping channel choices have impacts on shopping travel frequency. Hence it affects goods distribution flows. On one hand, e-shopping can substitute end customers shopping trip; on the other hand, more freight traffic might be generated due to home delivery (Francke & Visser, 2015). Comi & Nuzzolo (2016) conceptualizes urban freight flows by three types of mobility, which are shopping mobility, shop restocking mobility and e-purchase delivery mobility. The structure of urban freight flows is illustrated as follow in the Figure 2-4:

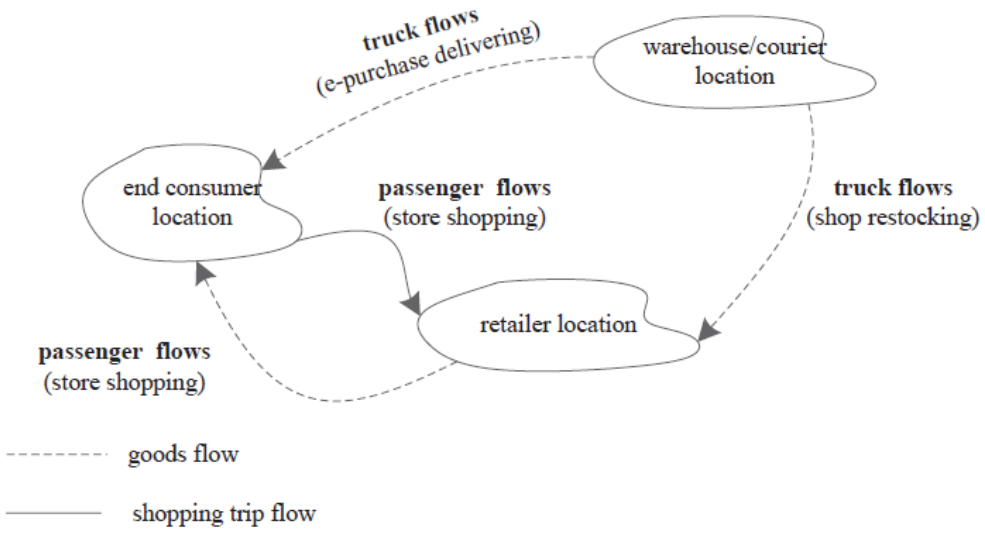

Figure 2-4. Urban freight flows structure

Source: (Comi and Nuzzolo, 2016)

Freight distribution system is influenced by e-shopping (Comi & Nuzzolo, 2016). Traditionally, manufacturers, wholesalers and retailers make big-lot transportation and the freight transportation volume among them is thick. The last-mile delivery is made by consumers by conducting shopping trips. In the case of e-shopping, small-lot deliveries are made in order to deliver the goods to consumers or pick up points. The thick inter-city transport can be de-consolidated and the last mile transport is carried out by small vans or trucks (Visser, et al., 2014). There has been criticism that small-lot delivery increases traffic volume. However, as

the last-mile delivery by retailer or wholesaler substitutes shopping trips, it is reasonable to assume that total volumes of freight and passenger transport in terms of vehicle-km would not change so much (Visser, et al., 2014). Sustainable city logistic policies could be applied to promote efficient last-mile freight transportation in urban areas. Therefore, it is important to analyse what policies could be implemented and how they could be used.

2.4 Previous studies on consumer channel choice and methodologies used

There are extensive studies on consumers channel choice and a wide range of methodologies have been used. For the application considered here, because online grocery account for only 1% of Norwegian grocery market, there is a lack of observation with respect to actually consumer data recording their behavioural parameters. As this research aims to investigate the potential demand of E-grocery in Norway, stated preference choice modelling will be adopted as main approaches in order to capture information about preferences for E-grocery services. Stated preference discrete choice modelling is particularly advantageous in the evaluation of new product and programs where market information is not available.

Stated preference (SP) method is used to ask people questions within hypothetical situations in order to see how people respond to a range of choices (Johnston, et al., 2017). The extent of collective willingness to pay can be estimated based on the results of questionnaires. SP depends on what people say, rather than what people do. It is a flexible technique that can be applied in almost any economic valuation context. SP method provides estimation of values linked to changes in economic welfare brought by a change in the world (Johnston, et al., 2017).

SP method becomes popular in marketing research since the early 1970s (Sanko, 2001). There are multiple variations of SP. Johnston et al. specify two SP approaches: one is discrete choice contingent valuation, where the survey is used to investigate whether respondents would vote for a proposed change at a specified cost; Another common approach is discrete choice modelling, where respondents are asked to indicate their preference among alternatives with multiple attributes (Johnston, et al., 2017).

In existing literatures, revealed preference (RP) technique are often mentioned together with SP. RP has primary advantage that the choice modelling is based on actual choices, and it avoids the potential problems associated with hypothetical scenarios. This can also be the main

drawback of revealed preference methods. Analyses are largely limited to observations of the world. Revealed preference is not suitable for potential markets where attributes cannot be observed (Hicks, 2002).

Compared to revealed preference methods, the most obvious advantage of SP is that the alternatives included in the hypothetical choice set can be designed by the researcher. It is possible to include alternatives that may not exist yet at the time of study. SP allows one to explore the knowledge outside the technological frontier. Whereas the choice set decided in the revealed preference method ought to completely cover the whole real choice set considered by consumers. It is more difficult for analyst (Moore, 1990) (Hensher, et al., 2005). Second, SP is designed in a way that the number of marginal decisions can be maximized. In revealed preference, the consumers show clear preference to one alternative to all others. Little information is collected regarding their choice process and marginal decision (Moore, 1990). Third, the variations in attributes are difficult to observe in real world. With stated preference method, it is possible to observe the changes in preference affected by variations (Moore, 1990). Finally, SP data enables to recover repeated observations of preference from respondents. This gives models higher accuracy using smaller samples (Moore, 1990).

However, one of the biggest drawback of SP is the reliability. Stated preference is based on hypothetical situations. It is possible that the expressed preference is not consistent with the actual behaviour. Respondents can justify their actual behaviour or try to control policies (Sanko, 2001). Moreover, SP may lead to situations in which personal constraints are not considered as constraints at the time of making choice (Hensher, et al., 2005). Hence, estimates of demand levels derived from stated preference data needs to be carefully interpreted.

Choice modelling are widely used in consumer channel choice in previous studies. Degeratu et al. (2000) study consumer choice behaviour in online and offline stores in USA using revealed panel data. The research assesses whether brand names, price, and other search attributes have higher impacts on online or offline. Degeratu et al. (2000) use two comprehensive longitudinal field data set from separate samples of online and offline shoppers. A two-stage choice modelling framework was developed accordingly in order to test price sensitivity and brand loyalty between online and offline grocery shoppers. The research finds out that brand names become more important for online shopping when information on fewer attributes is available online. Whereas price sensitivity is higher online due to strong indication of price discount in online channel. The visual cues of the product have lower impact on choices online while

factual information have higher impact on online choice. The study has proposed some methodological innovations to compare offline and online data. However, since one of the data source is limited to a subscription based online grocer, the study does not discover the choice behaviours in online market that are not subscription-based (Degeratu, et al., 2000).

Ming-Hsiung (2009) utilizes stated preference method to acquire data and to explore how consumers allocate their time and cost resources between online and physical bookstores. The article focuses on the value of time and derive it from time and cost attributes. Through the stated preference experiment, the value of delivery time and the value of travel time are calculated by the estimated coefficients of time and cost variables. As results, the paper finds the price strategy to influence consumer shopping channel choice and claims that the benefits from saving travel trip are more than lost from waiting delivery for online shopping. In this paper, the author believes that shopping as a process contains many elements, and he selects three noticeable steps for evaluating shopping mode choice which are information gathering, purchasing and delivering. However, the shopping process is highly related with the type of products. Grocery has less requirement for information gathering. Moreover, Ming-Hsiung addresses that although the paper only considering economic function and ignore the influence of psychological attributes, the state preference can moderate this deficiency. This would be useful for the following part of selecting key attributes for grocery shopping channel choices (Ming-Hsiung, 2009).

Valentini et al. (2011) use logit choice modelling to investigate how consumers decide which channels to choose for purchasing and how that decision process changes over time. Consumers channel decision process is dynamic and evolves gradually. Valentini et al. use two data sets: a book club retailer with three sales channels, and a durables/apparel retailer that has just introduced a new purchase channel. A two-stage model is developed. Stage one captures the evolution process and stage two contains two logit channel choice models, one for trial stage and one for post-trial stage. The results provide evidence to their hypothesis, that the consumers channel choice decision evolves, the time of the evolution varies across customers, and customers become less responsive to marketing effort over time. The limitation is that the study is based on purchasing histories, and the population of interest is heavy users who account for high sales. Therefore, the study does not cover consumer behaviour for potential new users (Valentini, et al., 2011).

Melis et al. (2015) identify the drivers of online store choice and explored how these drivers change when multichannel shoppers gain online grocery shopping experiences. This study builds on random utility maximization principles and uses multinomial logit model across all multi-channel retailers in UK. The research objectives are empirically investigated by using dataset from a large UK grocery retailer. The results provided evidence that when consumers start buying groceries online, they tend to select the online store belong to the same chain as their preferred offline stores. If the online and offline stores have good integration in marketing effort, the positive association of offline preference on the online store choice probability will be stronger. The offline environment is important when customers are new to the online channel. However, it becomes less important with respect to online environment when consumers gain experience with online grocery shopping. The limitation is that the study ignores product category differences. In addition, the panel dataset entails constraints, which may not completely capture consumers perceptions and preferences (Melis, et al., 2015).

Suel and Polak (2017) study consumers' choice behaviour by developing discrete choice models for joint choice of channel, shopping destination and travel modes (Suel & Polak, 2017). The study collects consumer panel data from two selected boroughs in London and develops two-staged model to represent the channel choice behaviour for each shopping occasion. The result of the study shows online alternatives attracts earlier online adopters for large basket shopping and for high income groups. Furthermore, the online groceries substitute mostly driving trips, and not so much walking trips. However, their study did not discover the association on attributes that can influence consumers choice, such as pricing strategies, delivery prices, delivery time and so forth. This limitation can result from limited data and sample size issues (Suel & Polak, 2017).

To sum up, with noticeable exceptions, previous studies on consumer channel choice mainly use revealed data to model consumer choices. Attributes, drivers and consumer behaviours on different channel were discussed in previous literatures. However, there is a lack of focus on grocery shopping in previous channel choice modelling. The innovation in the present study are discussed as follows. Firstly, it creates a detailed database concerning Norwegian consumer channel choice in grocery shopping. The data set includes consumers current grocery shopping behaviour and stated choices. Moreover, this study asks detailed questions about the acceptability of attributes and levels employed to describe three choice alternatives: in store, home delivery and click-and-pick. Even more importantly, labelled stated preference choice experiments are used to estimate specific utility functions for each grocery shopping

alternatives. This information is relevant both for grocery retailers as well as public policy makers.

2.5 Theoretical framework

2.5.1 Introduction

The term of theory relevant for this paper is social and economic theory which provides a theoretical framework to interpret social structure and phenomena. It presents a systematic way to understanding events, behaviour or situation with a set of concepts. Besides, a model could be derived from a theory through experiment test or empirical observation to describe behaviour or make prediction for the future (Garner, et al., 2009). Therefore, the role of theory in the research is addressed "any scientific finding is always to be assessed in relation to the theoretical perspective from which it derives and to which it may contribute" (Silverman, 2013, p.72). As a foundation of investigating demand for grocery shopping online, the microeconomics of consumer theory and random utility model will be discussed in the following part.

2.5.2 Consumer theory

"Consumer theory is to demand as producer theory is to supply" according to McAfee (2009, p.2). The difference is producers care about profit which can be measured directly, whereas consumers concern for maximizing their satisfaction from consumption decisions which is hard to measure straightforward. Therefore, there is a premise for the consumer theory, that consumer preferences can be inferred by the choices they make (McAfee, 2009). Microeconomic consumer theory is the study how people decide what to choose to maximize their utility affected by their preferences and budget constraints (Chugh, 2015). In the economic expression, it can be explained as choosing the best products or services at affordable price. The concept of best is related to consumer preferences. Similarly, the neoclassical economic theory points that people have rational preferences between choices and the result will be assign the value which is called utility. Individuals maximize utility by balancing their income-constrain (Bierlaire, 1998). Basically, consumer theory contains a several concepts to define and explain phenomena such as consumer preferences and utility.

Consumer preference involves the ranking of goods and services according to how much benefit they get or the amount of satisfaction they achieve from a given market basket. Ranking, rating and choosing are three conventional ways to evaluate different options based on desirability to

present consumer preferences (Varian, 2014). Utility represents the level of happiness or satisfaction that consumers experience from products or services. Utility function is a way to describe consumer preferences through presenting how the goods or the services satisfy consumers wants. Researchers deem that utility function is an economic equation which reveals people's willingness to pay for different goods or service to satisfy their desires (Adamowicz, et al., 1998). Moreover, Lancaster (1966) addresses that the utility of a product is derived from its properties towards consumers. Therefore, it is essential to identify the characteristics of goods or services to create valid utility function.

According to the consumer theory and related concepts, to explore Norwegian consumer preferences for different types of grocery shopping channels, different utility functions with a set of attributes for choice making will need to be identified.

2.5.3 Random utility theory

Random utility theory (RUT) is introduced by Thurstone (1927), and then developed by McFadden (1986) with multiple comparisons of choice alternatives (multinomial logit model). It becomes popular in market survey because economist found the collected results can be used to analyse the impacts on demand by changing products attributes or introducing a new product. RUT supposes that consumers are rational decision makers. They have a latent utility function in their head for each different choice alternatives which can be used to predict consumers choice or explain consumer choice behaviour instead of numbers, and consumers try to maximizing the utilities relative to their choices (see Figure 2-5) (Cascetta, 2009).

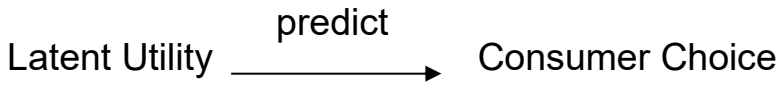

Figure 2-5. Assumption for RUT

Human behaviour is subjective because there exist individual differences and they are not perfect measurement tools. The variability can be introduced by human factors instead of choice option per se (Louviere, et al., 2010). During performing the survey, analysts cannot observe or include all the factors affecting consumer preferences (Baltas & Doyle, 2001). Also, the measurement errors and other errors will not be avoided completely. Consequently, the utility function should capture different types of errors or uncertainties (Louviere, et al., 2000).

Regarding to the assumption of uncertainty, the random utility model with deterministic decision rule will be introduced where the uncertainties are captured by the random variables (Bierlaire, 1998). Therefore, the RUT proposes that the latent utility model consists of two parts which are deterministic (systematic) component and (random) component, written as (2.1).

$$U_i = V_i + \varepsilon_i \qquad (2.1)$$

U_i represents the utility of the specific altherniative$i$. V_i is the part of systematic component and ε_i is the error term for uncertainties. V_i and ε_i are independent and additive (Hensher, et al., 2005). The level of utility is not an absolute value. It is a relative measure against the base reference, so that the alternatives can be compared within the same choice set (Hensher, et al., 2005).

In order to present V_i, a qualitative approach involving primary and secondary research (focus group, in-depth interview, questionnaires and literature review) ought to be conducted. The attributes of each alternative that attracts consumers to choose can be identified to establish utility expression, written as (2.2) (Adamowicz, et al., 1998). In (2.2), β is called coefficient which assigns important meaning for every attribute and provides meaningful values to the analyst. The sign, significance and weight of each coefficient demonstrate how the specific attribute influence the utility outcome and at which level with its importance. Besides, coefficients can be used to calculate value of time or to compare the groups differences. β_{0i} is the alternative-specific constant which is not associated with any of measured attributes. It implies the current market share of the specific alternative compared with the base reference (Hensher, et al., 2005).

$$V_i = \beta_{0i} + \beta_{1i}X_{1i} + \beta_{2i}X_{2i} + \ldots\ldots + \beta_{ki}X_{ki} \qquad (2.2)$$

In short, the latent utility functions for different choices are estimated or assumed by the researchers including key attributes with coefficient and random errors. In the context of consumer purchasing patterns, different random utility functions will be used to analyse how the key factors influence consumers making choice for different grocery shopping channel based on state preference data.

Discrete choice modelling

As a way to analyse collected data, discrete choice model (DCM) is derived from RUT which is assumed as decision rule for modelling. People are assumed to try to maximizing random

utility and choose an alternative that can yield the highest satisfaction for them in an imperfect market. However, the analyst is not decision maker. Due to the existence of random component, they can only estimate the probability of an alternative being chosen by a person (Louviere, et al., 2000).

Discrete choice models take many forms such as binary logit, binary probit, multinomial logit (MNL), multinomial probit, nested multinomial logit (NMNL), mixed logit, and exploded logit. As an important choice model, MNL model is the most popular one to be used for discrete choice analysis, and the form is written as (2.3) (Hensher, et al., 2005). For MNL model, the particular distribution of random component is the extreme value type 1 (EV1) distribution. Contrasting with normal distribution, EV1 has extreme values reside in the tails of the distribution. MNL model is the result of impacts of IID (independently and identically distributed) towards the random component (Louviere, et al., 2000). There is no covariances since the alternatives are independent, and the variance are identical. McFadden (1986) presumes that if the random components are IID, the Gumbel distribution could generate closed form expression for the choice probability. Therefore, under the situation of more than two alternatives with the assumption of no correlation in unobserved factors over alternatives, MNL model is selected as a suitable model for this paper.

$$Prob_i = \frac{expV_i}{\sum_{j=1}^{J} expV_j};\ j = 1, \ldots\ldots, i, \ldots\ldots, J \quad i \neq j \tag{2.3}$$

It is worth noting that comparing with other relevant method could give a great help on having better understanding on DCM per se with its advantages. As mentioned, there are many fashions to analyse state preference data from individuals. Two general and popular paradigms for SP that used by substantial empirical studies over more than 30 years are conjoint analysis (CA) and DCM. Louviere, et al. (2010) claim that many researchers did not recognize the differences between CA and DCM, and it is misleading to call DCM as a choice-based conjoint analysis.

First, due to the similar survey process of combination of attribute levels, it is more easily for people to believe DEM resembles CA. However, the error component is the key difference between them. The random components are considered at the beginning for DEM, but for CA, it is an afterthought (Louviere, et al., 2010). Secondly, CA is derived from the theory of conjoint measurement (CM), and it is believed as a mathematical way to present the ranks of full factorial design. It focuses on the behaviour of number system instead of consumers preferences per se. As a result of inconsistency with economic consumer theory, CA can not cover the whole

decision-making process and loss concentration on prior process. However, DCM is based on the RUT which is a well-established behaviour theory. It has ability to consider different stages of decision making process, utility maximization and budget constraint. It is more realistic that consumers may keep the status quo because they cannot afford it. Therefore, the choice set for DCM includes the alternative of status quo or no purchase normally, and it can naturally yield willingness to pay as well (Louviere, et al., 2010).

To summarize, the demand is the embodiment of the decision result, and the result include a choice made from a set of finite alternatives. As defined by Bierlaire (1998), a model is used to simply describe the reality to better understand the complex system that is consumer behaviour towards choice decision. Therefore, in order to analyse consumer preferences, two central models need to be established. They are the utility function of each alternative with its specific attributes and parameters and the function related with probability of each utility for each alternative. The utility expression models and MNL model will be applied in this paper to predict future trends for grocery shopping channels in Norway and investigate how people's choice will change under the changes of attributes or demographics. Figure 2-6 illustrates the idea of the theoretical framework for the purpose of this paper.

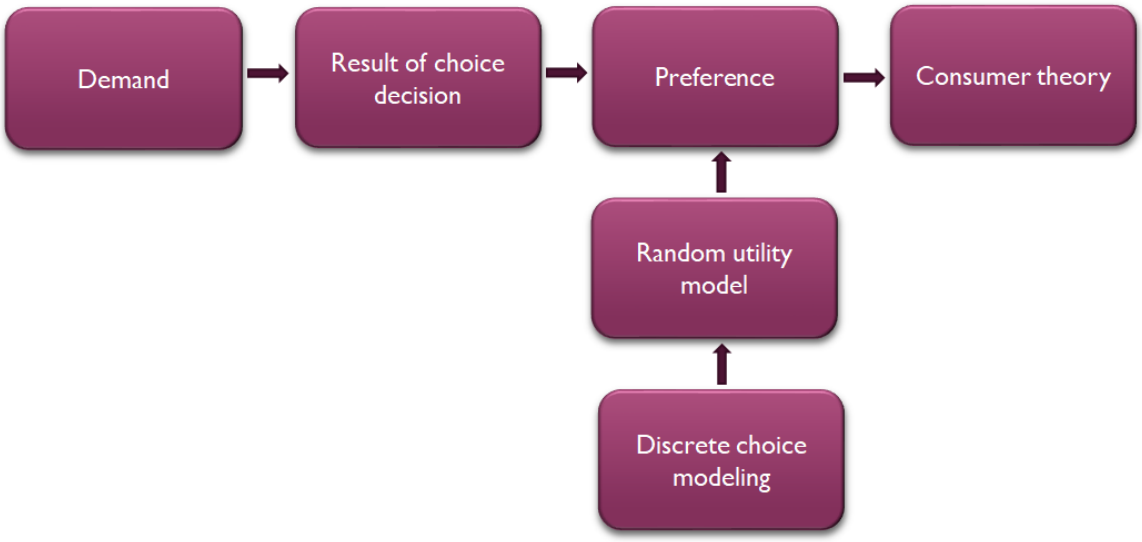

Figure 2-6. The idea of theoretical framework

2.5.4 Experimental design

"A designed experiment is a way of manipulating attributes and their levels to permit rigorous testing of certain hypotheses of interest" (Louviere, et al., 2000, p.84). Experimental design plays an important role for the stated choice experiments which aims at identifying the

independent impact of all attributes on the results. Numerous respondents will be asked to answer a series of choice tasks. For each choice task, a hypothetical scenario with different alternatives defined by different and pre-defined attribute levels will be shown to respondents and they will be asked to select the one that they prefer within finite choice set (ChoiceMetrics, 2018).

Factorial design is the presentation of full possible combination of all attributes with their different levels, so the enumeration is also known as "full factorial". It means that the experimental design populates all the hypothetical and possible choice situations to let respondents consider and answer. The equation for the total number of choices situations in a full factorial design is presented in (2.4).

$$S = \prod_{j=1}^{J} \prod_{k=1}^{K_j} l_{jk} \qquad (2.4)$$

where

J represents alternatives,

K_j represents attributes, $k \in K_j$

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

Underlying the statistical properties, factorial designs make sure that the effects of interest for a particular attribute are independent, such as means, variances and slopes. The possible interaction effects between attributes can be estimated as well in the full factorial design (Louviere, et al., 2000). However, the disadvantage of full factorial design is the requirement of huge number of size. When the numbers of alternatives, attributes and levels increase, the complicity of the design will exponentially increase. According the sparsity-of-effects principle, high-order interactions rarely produce bias to the main and two-way interaction estimate (Wu & Hamada, 2000). Dawes and Corrigan (1974) also state that the main effects and two-way interactions could explain 70% to 90% and 5% to 15% respectively of variance. Therefore, not all interactions are significant and meaningful for the estimation, and the omitted effects account for a little variance. The fractional factorial design is derived from this idea which is used to systematically select the subset of attribute combinations from the complete factorial design (Louviere, et al., 2000).

Orthogonal design will be generated to derive a fractional factorial design instead of random

selection. The assumption behind orthogonality is that there is zero correlation between attributes, so the choice tasks are selected under the situation that the attribute levels are orthogonal (ChoiceMetrics, 2018). The reason for choosing orthogonal design is that it not only reduces the number of combinations, but also it allows the independent estimation of every attributes contribution on the choice can be achieved statistically. Orthogonality is believed to minimize the variances of the estimate from the variance-covariance matrix (ChoiceMetrics, 2018). In this paper, orthogonal factorial design will be used through Ngene software as a suitable and efficient method to design questionnaires.

3. Methodology

3.1 Introduction

This chapter will present the research method applied to this project. Figure 3-1 illustrates the framework of stated preference experiment (Louviere, et al., 2000). Firstly, problem definitions are refined. Then supporting qualitative studies are carried out in order to refine a list of alternatives, attributes and their levels. Two in-depth interviews are conducted on 15th January 2018 and 30th January 2018 respectively. One focus group interview is performed on 4th February 2018. The goal is to obtain a broad idea about Norwegian consumers' attitudes to online grocery services and to define important attributes that can be used in the stated preference survey. After the qualitative studies, a small-scale survey is done in order to refine the list of attributes and levels.

Later a pilot stated preference survey is designed on 13th March, and a small sample of 47 respondents are collected in Norway. Primary analysis and estimations are carried out in order to test the efficiency of the pilot survey. Based on the pilot survey, the improvement is made to the main questionnaire. The main SP questionnaire is used to collect 202 interviews (including the 47 interviews conducted previously). Econometric models will be estimated based on the 202 samples collected.

A SP project requires iterative evolution. Therefore, several of the steps in the framework are intertwined (Louviere, et al., 2000). In the following part, the main steps needed to conduct the SP experiment study will be discussed.

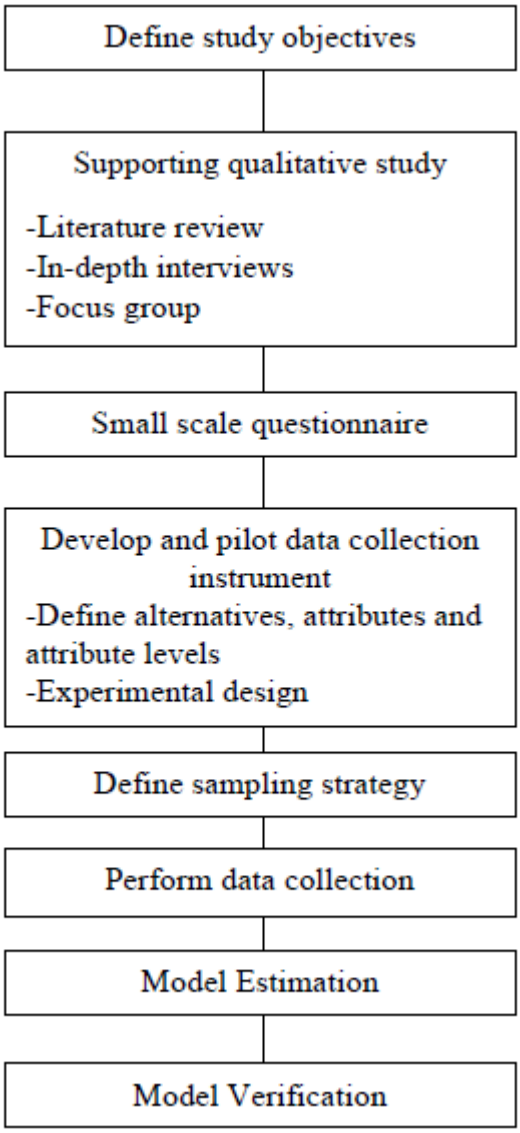

Figure 3-1. Framework of stated preference experiment

3.2 Define study objective

The research problem of this study is to investigate Norwegian consumers potential demand on E-grocery. A refinement of the problem is to model Norwegian consumers channel choice between online and offline alternatives when it comes to grocery shopping. The SP choice experiment is used to answer two questions: What factors affect and how they affect consumers channel choices? How will the Norwegian E-grocery market share change in the future?

3.3 Data collection methods

Various methods are used for data collection. In-depth interviews and focus group interview are adopted as supporting qualitative methods for the purpose of developing the questionnaire and

understanding the Norwegian E-grocery retailing environment. Two types of questionnaires are used to collect quantitative data. The following part will give a thorough discussion on all the data collection methods used.

3.3.1 In-depth interview

Interview is described as a conversation which goes in depth on a subject of interest. Two semi-structured in-depth interviews are performed for the purpose of understanding Norwegian consumers behaviour. This is to define attributes and attribute levels. Semi-structured interviews are often based on a predefined set of questions or a manuscript (Rogers, et al., 2011). The interview can deviate from manuscript to ask for clarifications, follow-up questions. Questions can be shuffled by rearranging them to better fit the conversation. In a semi-structured interview, it is important to not expect a particular answer. Semi-structured interviews use both closed and open-ended question, and explorative questions such as "is there anything more you want to address?" (Lazar, et al., 2017). In this study, semi-structured in-depth interviews are conducted as supportive qualitative studies. Two interviews are conducted in order to obtain information on factors affecting Norwegian consumers grocery channel choice. Both of the interviewees have previous experience of shopping groceries online. The analysis derived from interviews are used to refine the list attributes. The question lists are presented in the Appendix I.

3.3.2 Focus group interview

Another supportive qualitative study used is focus group interview. The purpose of conducting a focus group is to listen and gather information. It is a way to better understand how people feel or think about an issue, product or service. Participants are selected due to certain characteristics in common that related to the topic of the focus group. The intent of the focus group is to encourage self-disclosure among participants (Krueger & Casey, 2008). Focus group is most suitable for conducting an unstructured or semi-structured interview. It follows a prepared set of questions but has high flexibility. Discussion can unfold and the researchers can go deeper into interesting themes with follow-up questions. Focus groups allows divers and sensitive issues to be raised. However, the main drawback is that the interaction between interviewers can lead the participants to affect each other. In addition, there is a possibility to raise biased answers. (Rogers, et al., 2011) (Lazar, et al., 2017).

One focus group interview is performed on 4th February 2018. The objectives are to find aspects of online and in-store grocery shopping that can act as attraction or aversion factors. The goal is to identify important attributes characterizing the online grocery shopping alternatives that might be used in the SP survey. Additionally, focus group interview could identify potential attitudinal questions that might be included in the SP survey. The question guidelines are presented in the Appendix I.

3.3.3 Questionnaire

Questionnaire is used to collect demographic data and people's opinions. It is a well-established technique which can have closed and open questions. Questionnaires should include basic demographic information and details of user experience. The background information is needed to find out the scope within the sample group. Following the general questions, more specific question can be designed to contribute the evaluation goal. Different format of questions can be applied, including check boxes, ranges, scores, and like scales (Rogers, et al., 2011).

Questionnaire is typically self-administered by an individual. Due to this reason, the data collected is not as deep as in-depth interview and focus groups. Therefore, questionnaires are often used in combination with other methods in order to get a better understanding of the matter studied. Questionnaire allows one to collect data relatively fast. In addition, it allows one to make statistically accurate estimates for a population (Rogers, et al., 2011) (Lazar, et al., 2017).

In this study, two types of questionnaires are used. A small-scale questionnaire is used to define the most important attributes affecting consumer channel choice. The small-scale survey served the purpose of defining the main SP questionnaire. SP questionnaire is accordingly designed to collect main data for model estimations.

3.4 Experimental design

Louviere, et al. (2000) address that an experiment involves the manipulation of variables and obervation of valus of variables. Such variables can be called "factors", or attributes if they represent features or characteristics of products (Louviere, et al., 2000). The variables values are termed "levels". After the identification of alternatives, attributes, number of attribute levels, and the attribute level labels, decisions must be made as which treatment combinations to be used.

Full factorial design is the most general class of design available. It is a design in which all possible treatment combinations are enumerated. The experimental design literature has created a coding format that may be used to each attribute level. The full enumeration of possible labelled choice sets is presented in equation (2.4). The equation yields $(3 \times 3 \times 3)(3 \times 3 \times 3 \times 3 \times 3)(3 \times 3 \times 2 \times 3 \times 3) = 1\,062\,882$ combinations.

3.4.1 Labelled versus unlabelled experiments

Experiments that use generic titles for the alternatives are called unlabelled experiment. Instead, each alternative in the experiment can be labelled with a name. Such experiments are termed labelled experiments. The decision as to whether use labelled or unlabelled experiments is an important one. The main benefit of using unlabelled experiments is that they do not require the identification and use of all alternatives in the universe. Moreover, the IID assumption which imposed the restriction that the alternatives used in the modelling process be correlated is more likely to be met with unlabelled experiments. However, Green, et al. (2005) advocate that if one wishes to estimate alternative-specific parameter estimates, it is best to use labelled experiments. Also, labelled experiments are used due to the purpose of realism (Hensher, et al., 2005).

In our study, it is specified in the research problem that the objective is to investigate consumers' channel preference in grocery shopping. Therefore, when decision makers are asked to choose mode of grocery shopping, they do not choose from generic alternatives, but a number of alternatives linking to online/offline channel choice. In this study, the focus is on the prediction and establish willingness to pay (WTP) for specific attributes. A labelled experiment is preferred (Hensher, et al., 2005).

3.4.2 Fractional factorial design

Rather than using all 1 062 882 possible treatment combinations, it is possible to use a fraction of the combinations. Designs using fraction of the total number of treatment combinations are called fractional factorial designs. A number of combinations to can be chosen randomly. However, randomly selected combinations can produce statistically inefficient or sub-optimal designs (Hensher, et al., 2005).

Hence, in this study, a simultaneous orthogonal factorial design is applied in order to choose the subsets in such a way that attribute level balance is satisfied. An orthogonal design satisfies attribute level balance and all parameters are independently estimable. This requires that

attribute levels for each attribute column in the design need to be uncorrelated. Additionally, an orthogonal design satisfies the property that the sum of the inner product of any two columns is zero. The orthogonality of data is considered important in linear models. Orthogonality prevents models from multicollinearity, and orthogonality is thought to minimize the variance of the parameter estimates. Nevertheless, in the choice data sets, orthogonality is expected to be an exception. Orthogonality is likely to be lost in the estimation process of the data set (ChoiceMetrics, 2018).

Ngene program can either generate a sequential orthogonal design, or a simultaneous orthogonal design. In sequential orthogonal design, orthogonality is held only within each alternative. Whereas in simultaneous orthogonal design, orthogonality is held across the alternatives (Hensher, et al., 2005). The sequential orthogonal design usually gives smaller number of choice situations. The orthogonal array is determined for the attribute of the first alternative, then other alternatives. Therefore, sequential orthogonal design is more suitable for unlabelled experiments, or in experiments where utility function has the same attributes with same levels (Hensher, et al., 2005). In this research, simultaneous orthogonal design is applied due to the fact that different alternatives have different attributes and attribute levels.

3.4.3 Blocking the design

Even if orthogonal design has been developed, there still can be too large number of choice set to a single respondent. A widely used strategy is called blocking, which can split the orthogonal design into smaller designs. Each block by itself is not orthogonal, only the combination of all blocks is orthogonal (Hensher, et al., 2005). By blocking, attribute level balance is satisfied so that each respondent does not only face high or low levels for a single attribute (Hensher, et al., 2005).

Blocking introduces an extra uncorrelated column with a number of levels. The levels are used to segment the design. In our design, the new attribute has 6 levels, and the design is broken down into 6 blocks. Each block will be given to a different respondent. The result is that 6 different decision makers are needed to complete the full design.

3.4.4 Efficient design

If a design produces data that can be used to estimate parameters with lowest possible standard errors, such design can be called efficient design (ChoiceMetrics, 2018). In orthogonal

fractional factorial design, statistical independence is prioritized, yet the statistical efficiency is rarely considered. Efficient design will benefit from statistical efficiency but correlations can occur (Hensher, et al., 2005). Therefore, both orthogonal design and efficient design will be considered in this study.

The Asymptotic Variance Covariance(AVC) matrix linked to the data base with sample size N can be derived from an AVC matrix of a single experiment using rate of 1/N. The asymptotic standard errors of sample are the roots of the AVC matrix diagonal. Therefore, with the sample size of N, the asymptotic standard errors reduce at a rate of $1/\sqrt{N}$ (ChoiceMetrics, 2018). As illustrated in Figure 3-2, when sample size increases, the standard error reduces. With low efficiency design, increasing sample size will not significantly reduce standard errors. However, a design with high efficiency will optimize the diminishing of standard error with the given sample size. Therefore, it yields parameter estimation with lower standard error without collecting additional data (ChoiceMetrics, 2018).

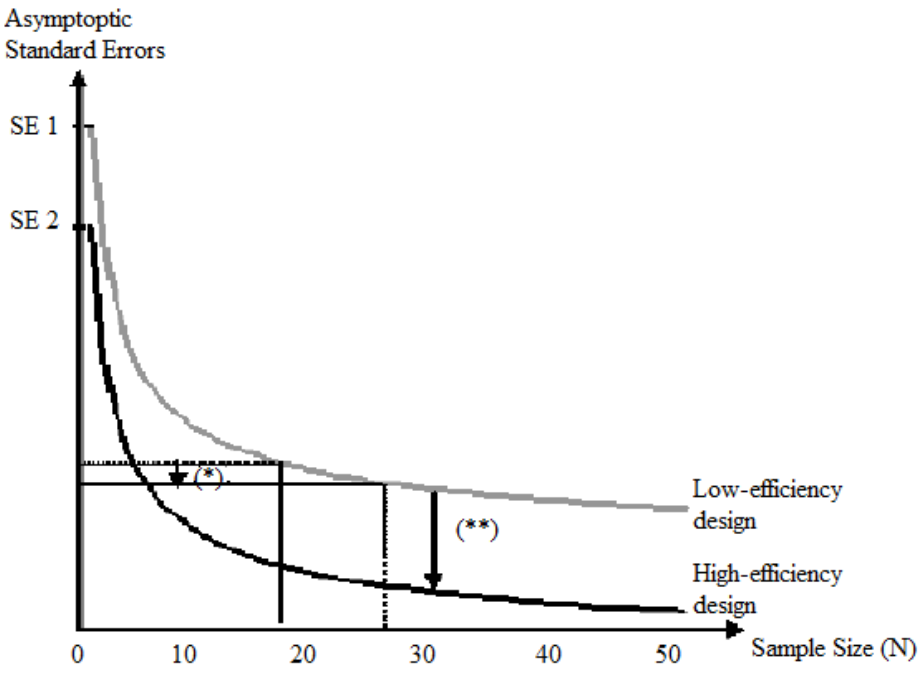

Figure 3-2. Asymptotic standard error as a function of the sample size

Source: (ChoiceMetrics, 2018)

There are many ways to measure efficiency. In our experiment, a S-optimal efficiency design is applied. The measurement is linked to the sample size needed in order to make significant estimation of each parameter (ChoiceMetrics, 2018). A sample size N is required in order to ensure the significance of a parameter and reject null hypothesis $\beta_k=0$. Some parameters may

need higher sample size than others. Therefore, it is argued that the experiment can prioritize on the parameters that are more difficult to estimate significantly. The design which can be optimized for sample size is termed as S-optimality design (ChoiceMetrics, 2018).

3.5 Define sampling strategy

Sampling frame and sample size should be carefully designed. The sampling frame defines the universe of respondents from where a finite sample is taken in order to perform the data collection (Louviere, et al., 2000). The objective of this study is to investigate the potential demand of E-grocery in Norwegian market. Therefore, the sample frame will be the residents in Norway. Random samples will be collected so that the sample can be representative of the population.

Due to the fact that the sampling frame can be infinite in size, one needs to define sampling strategy and sample size. Two common sampling strategies for choice models are simple random samples (SRS) and exogenously stratified random samples (ESRS). This study adopts SRS sampling strategy, where each respondent in the sampling frame has an equal likelihood of being selected for the sample (Louviere, et al., 2000). In order to ensure the data are randomly collected, a variety of locations (airport, ferry, shopping centres) and survey methods (social media based, face to face) are selected to perform data collection.

For simple random samples, when an estimate $\hat{p}$ is unknown, $\hat{p}$ can be replaced by 0.5. Number of samples required for 95% confidence interval is presented in formula (4.1)

$$n=1.96^2 \cdot 0.25/E^2 \quad (4.1)$$

when an estimate $\hat{p}$ is known, number of samples required for 95% confidence interval is presented in formula (4.2)

$$n=1.96^2 \hat{p}(1-\hat{p})/E^2 \quad (4.2)$$

Where E is the margin of error, $\hat{p}$ is the estimation of the population proportion p. (Triola, 2006)

This study adopts the statistic estimated by Nielsen, that 11.6% of Norwegian consumers used E-grocery service in 2016. In order to be 95% confident, and the margin of error to be no more than 4%, 231 samples are needed.

3.6 Data analysis methods

Data analysis can be done in different ways depending on the research methods and the type of data collected, which can be qualitative and quantitative. Some of the data analysis techniques relating to this research are presented here.

3.6.1 Thematic data analysis

Thematic data analysis is used to analyse qualitative data from interviews. Braun and Clarke (2006, p83) defines thematic analysis as "*…a method for identifying, analysing and reporting pattern within data".* The thematic data analysis is a core approach for analysing qualitative data. Thematic data analysis has high flexibility and is suitable for interpretive contexts. It gives a detailed and comprehensive interpretation of the data analysed (Braun & Clarke, 2006).

Braun and Clarke (2006) specifies that a theme captures the important part of data related to the research question. It represents a certain degree of pattern or meaning in the data set. There are primarily two approaches to capture the themes and patterns: an inductive bottom up way, and deductive top down way. The bottom up way means that the themes of the research is defined by data, whereas the data is not placed in predefined themes. The top down approach is driven by the predefined and less detailed research questions and themes. It is more explicitly analyst driven. The choice between inductive and deductive depends on how the data are coded. The data can be coded for a quite specific research question (deductive approach), or a research question that can evolve through the coding process (inductive approach) (Braun & Clarke, 2006).

3.6.2 Descriptive data analysis

Descriptive data analysis is used to analyse the pre-interview, post interview and social demographical data from SP questionnaires. Trochim and Donnelly (2006) point out that descriptive data analysis is used to uncover the patterns in data. It helps to present a basic feature of the research topic and the data set. Descriptive statistics can be used to compare across units of data. It forms the basis of most quantitative analysis of data (Trochim & Donnelly, 2006). The most commonly used descriptive measures include mean, median, mode, variance, standard deviations, and range (Lazar, et al., 2017).

Frequency distributions are often the first analyses to be done in a data set. Frequency

distribution is a valuable method for describing nominal or ordinal level data. It describes the number of subjects selecting each possible option and may include the percentage of the sample that this number represents. Another important descriptive analysis is central tendency, which measures where the middle of the sample lies. It can be conducted by analysing mode and median in the data set (Thompson, 2008).

3.6.3 Regression analysis

Regression analysis is used to estimate the utility functions of all three alternatives in this study. Chatterjee et al. (2000) state that regression analysis is one of the most widely used statistical tools for analysing multifactor data. They define regression analysis as a *"conceptually method for investigating functional relationships among variables"* (Chatterjee, et al., 2000, p. 1). The relationship can be presented in the form of an equation or a model connecting the dependent variable and independent variables. The task of regression analysis is to learn about a certain environment reflected by data (Chatterjee, et al., 2000). Lazar et al. (2017) point out regression analysis is mainly used for model construction and prediction. In case of model construction, regression analysis is used to identify the quantitative relationship between one dependent variable and a number of independent variables. In the case of prediction, a number of known factors (also called predictor variables) are used to predict the value of dependent variable (Lazar, et al., 2017).

Chatterjee et al. (2000) argue that regression analysis is a cyclical process, in which the outputs are used to analyse, verify, criticize, and possibly modify the inputs. The process has to repeat until one can obtain a satisfactory output. A satisfactory regression output can be described as an estimation that fits the data and satisfies the assumptions reasonably well. It is also argued that although the regression equation is the final product, there can be many by-products during regression analysis which cannot be neglected. The by-products can be as valuable as the final equation (Chatterjee, et al., 2000).

4. Description of Norwegian grocery retailing industry

This paper aims to investigate the potential demand for E-grocery shopping in Norway. In order to research the problem, a comprehensive understanding of Norwegian grocery retailing market is needed. In this part, different grocery segment in Norway will be discussed.

4.1 Segments of grocery retailing in Norway

Norwegian grocery retailing industry has a wide range of segments. Generally, the forms of retailing can be categorized into following types: supermarket, hypermarket, low price stores and convenient stores. The market share of each retailing segments in 2016 can be illustrated in Figure 4-1:

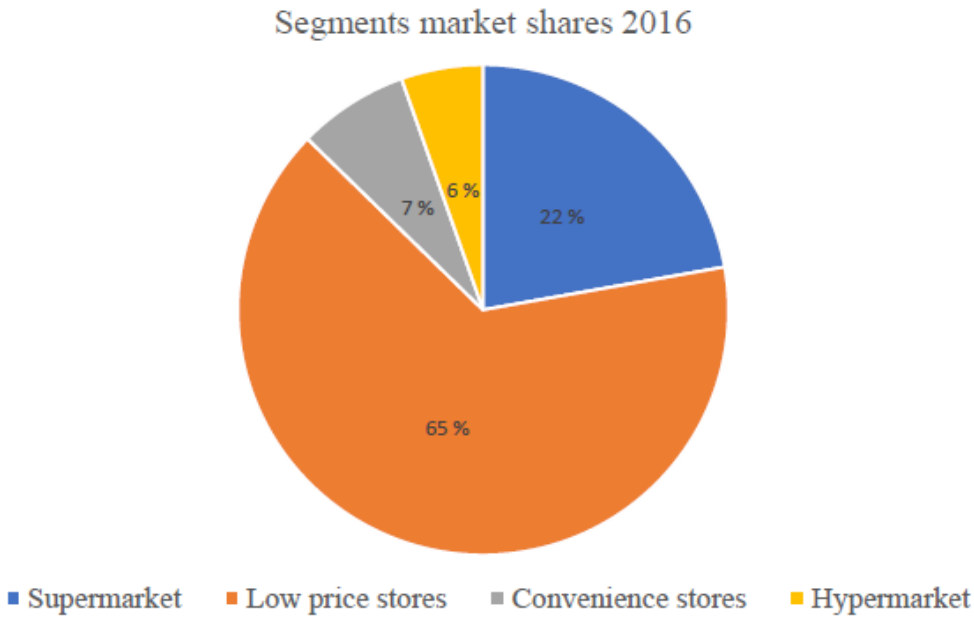

Figure 4-1. Norwegian grocery market segment shares

Source: (Nielsen, 2016)

Hypermarket is defined as a large retail business area (over 20000 m^2) with one or multiple owner. The assortment usually contains 60-70% of groceries and 30-40% of household products and leisure products. Hypermarket usually have both self-service and manned service. In Norway, the retailer that is closest to hypermarket concept is Coop OBS (Store Norske Leksikon, 2018).

Supermarket is the retail business area between 400 m^2 to 2500 m^2 (Nielsen, 2016). Supermarkets have a variety of assortment that cover most of the consumers daily needs,

including the needs for fresh products (fruit, meat, vegetable etc.). Example of Norwegian supermarkets are MENY, SPAR, and Coop Mega (Store Norske Leksikon, 2018).

Convenience stores, known also as neighbourhood stores, are the stores focusing on availability for one local area. They are usually stores with limited grocery assortment, such as food, toiletry, beverages, tobacco and newspapers. In Norway, examples of convenient stores are Joker and Matkroken (Store Norske Leksikon, 2018).

The concept of low-price stores can be overlapping with supermarkets. Low-price stores use price as their main marketing tool. Low-price stores do not possess any fresh food counter. The stores are often made easy with a high degree of self-service. Examples of low price stores are Rema 1000, Coop Prix, KIWI (Store Norske Leksikon, 2018). Prices are important to Norwegian consumers. Therefore, low-price segment has the largest market share according to the Figure 4-1. However, low-price stores in Norway are different from other countries. For example, Denmark, German and UK have “hard discount” stores like Aldi and Lidl. In Norway, KIWI, Rema and Ekstra can be described as “soft discount” stores with lower prices than supermarket, but much larger assortment than traditional low-price concept (Virke Enterprise Federation, 2017).

4.2 The main E-grocery retailers in Norway

The competition among different grocery retailers is hard. According to the Norwegian Grocery Report in 2017, there are three main grocery retailing groups in Norway, namely NorgesGruppen, Coop Norge SA and Reitangruppen (Virke Enterprise Federation, 2017). Among them, NorgesGruppen is the largest grocery retailing group and operates four major grocery store segments: KIWI, MENY, Joker and SPAR. Coop Norge SA operates a number of Coop brand stores and Extra stores. Coop Norge SA is the second biggest grocery retailer in Norway as it took over ICA group in 2015. The third biggest is Reitangruppen with Rema 1000. Bunnpris group accounts 3.9% of Norwegian grocery market share. Other small grocery retailers, including pure online grocery retailers, account for 0.1% of market share in total (see Figure 4-2) (Virke Enterprise Federation, 2017).

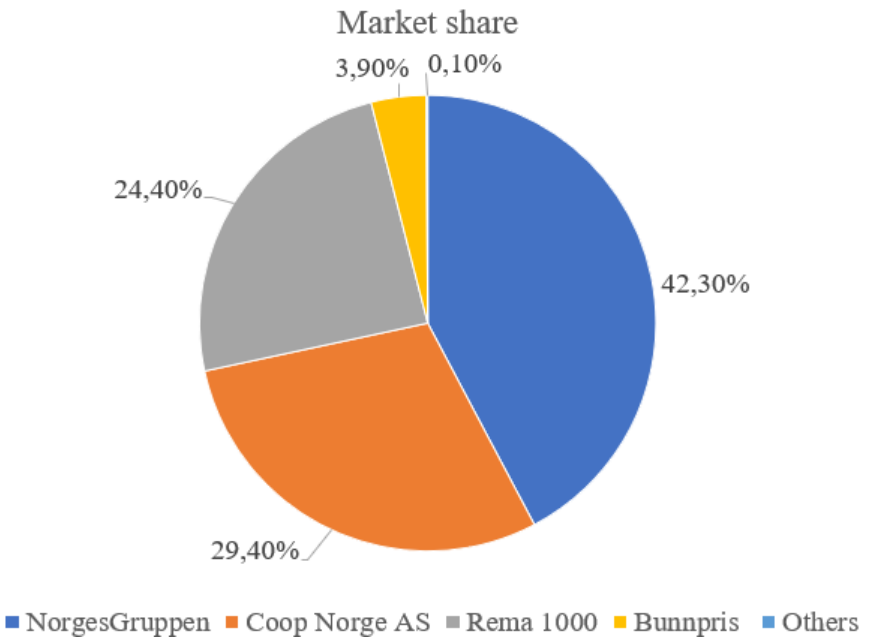

Figure 4-2. Market share of Norwegian grocery chains

Source: (Nielsen Grocery Report, 2017)

Norwegian online retail market is mainly shared between pure internet retailers and omni-channel retailers (Dreyer & Bakås, 2017). In Norway, Coop Norge AS and NorgesGruppen are the main players in multi-channel retailing. Coops online store does not sell grocery, only household equipment and leisure related products. Three NorgesGruppen stores offers online service, including MENY, SPAR and Joker (Virke Enterprise Federation, 2017).

The pure online grocery retailers have different business models. One of the model is subscription of dinner boxes and fruit and vegetable baskets, such as AdamsMatkasse and Godtlevert. The dinner boxes retailers offer only home delivery (Dreyer & Bakås, 2017). The other business model allows consumers to choose their own groceries online and get groceries delivered at designated places or pick up point, such as Kononial (Dreyer & Bakås, 2017). In this part, the main E-grocery retailers are discussed in order to have an overview of Norwegian E-grocery market. Policies of their online services are listed in the Appendix II.

4.2.1 NorgesGruppen

NorgesGruppen consists of parent company NorgesGruppen ASA and 312 subsidiary companies. The annual net income was 2.5 billion NOK in 2016 and the total capital was 36.4 billion NOK (NorgesGruppen ASA, 2017). NorgesGruppen owns the following grocery chain with different business strategies:

- KIWI: Low price segment. (Brick and mortar store).
- MENY: Large supermarket segment. (Multi-channel).
- SPAR/EUROSPAR: Supermarket segment (Multi-channel).
- Joker: Convenient store (Multi-channel).
- Jacobs: Gourmet grocery store only located in Oslo (Brick and mortar store)

The market share of each grocery store within the group is illustrated in the Table 4-3.

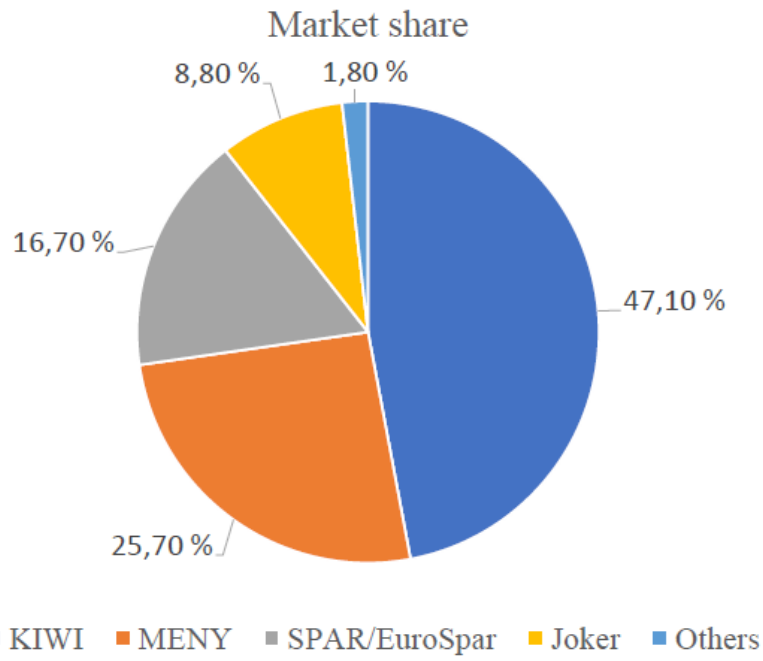

Figure 4-3. Market share of NorgesGruppen Stores

Source: (Nielsen Grocery Report, 2017)

Kiwi is the youngest low-price grocery chain in Norway. Among all the NorgeGruppen grocery chains, Kiwi had largest growth in 2016, both internally and externally. In 2016, the annual turnover of KIWI was 33 735 million NOK with 19.9% of national grocery retailing market share (NorgesGruppen ASA, 2017).

MENY differentiates from the low-price grocery chain as it offers a wide selection of products with high quality. It also has online purchasing channel. MENY can be categorized as a supermarket. In 2016, MENY had 10.9% of national grocery retailing turnover in 2016 with 18 414 million NOK annual turnover. One MENY store has averagely around 10 000 products

and 2300 categories from 450 local producers (NorgesGruppen ASA, 2017). MENY's online channel was open in 2017 and offers home delivery and click and pick. Their pickup points include MENY stores (drive-in), and a number of gas stations and convenient stores (drive-out).

Similar to MENY, SPAR offers good selection groceries. SPAR accounts for 7% of Norwegian grocery market. Currently, SPAR is a multi-channel retailer that offers home deliver and click and pick service. SPAR is the leading player in multi-channel retailing as its online channel is available in large part of Norway and its business is keep expending (NorgesGruppen ASA, 2017).

Joker has strengthened its position in convenient store segment. The turnover was 6 276 million NOK and the market share were 3.7% in 2016. Joker has its online channel with home delivery and click-and-pick offers. Joker's online store offers around 3000 products units (NorgesGruppen ASA, 2017).

In addition to the brands mentioned above, Norgesgruppe has directly-owned and partially-owned convenient stores. There is growth in chains Deli De Luca, Mix, Dolly Dimples, Jafs and Kaffebrenneriet (NorgesGruppen ASA, 2017).

As an important part of NorgesGruppen, ASKO is Norway's largest grocery wholesaler. ASKO supplies all the retailers within NorgesGruppe, as well as Bunnpris. ASKO has an effective national distribution network that ensures lowest price and best possible quality to retailers. In addition, AKSO supplies institutional catering sectors (ASKO, 2018). Throughout Norway, ASKO has 13 regional warehouses, 8 Storcash stores, which are Norway's largest cash and carry grossist. Moreover, ASKO has two central warehouses and one consolidation centre in Norway (ASKO, 2018).

Example: SPAR online shops in Møre and Romsdal

In Møre og Romsdal region, SPAR is the only multi-channel grocery retailer with two stores offering such services: EuroSpar Moa and SPAR Skjevik. EuroSpar's online store in Ålesund started in late 2016 and offers home delivery in Ålesund, Sula, Giske, Skodje, Vatne and Tenfjord. A semi-structured in-depth interview with E-grocery department manager of EuroSpar Moa is performed on 18th January 2018. The interview aims to obtain a comprehensive understanding of their business model as well as operation management. The interview guideline is attached in Appendix I.

SPAR sees the potential business opportunity in multi-channel grocery shopping and targets the newly sprout online grocery market. Therefore, SPAR is the first one in the Møre and Romsdal multi-channel grocery retailing market. The interviewee claims that SPAR and MENY are the only grocery chains that are capable of multi-channel retailing. Low-price stores like KIWI are more tied to cost control and thus do not have capability to provide E-channel. Online grocery retailing is still in a trial phase in this region. Strategically, the planning environment would be easier if the online channel is limited to two stores.

EuroSpar Moa collects online order every day and pick up the goods from the store. The order preparation time varies from 6 hours to 23 hours. The online channel has its own employees. However, if there is a large amount of ordering, employees from the regular store will help. If the store faces unexpected large amount of demand, in store customers and demand will be prioritized. EuroSpar Moa has designated drivers for home delivery, which uses a routine optimization program to decide the daily delivery routine. Currently they offer three delivery time windows, 10:00-12:00, 12:00-14:00, 16:00-18:00. The click and pick time window is from 20:00 to 21:00.

It is said that EuroSpar always pick up the groceries with best quality and freshest date according to the interview. It is also claimed that the price online is identical with the price in store (SPAR, 2018). However, in this study, a price investigation is carried out in order to verify the assertation. Through the price investigation of most frequently purchased grocery basket, it is found that the prices have slightly difference between offline and online channels. The price differentiation is only found in fresh and loose packed products (see Table 4-1).

Table 4-1. Price differences between offline and online channels of SPAR Møre

Product	Price Online	Price in Store
Bread (Grovbrød 750g)	37,9NOK/Piece	37,9NOK/Piece
Flour (1kg Møllerens)	11,5NOK/KG	11,5NOK/KG
Minced meat (torfe u/Salt og Vann 400g)	48,9NOK/Pack	48,9NOK/Pack
Fish (Kveite skiver 500g Fiskemannen)	119,0NOK/Pack	119,0NOK/Pack

Milk (Tine Skummet Melk 1L)	15,50NOK/Pack	15,50NOK/Pack
Egg (Egg Frittgående M/L 12stk Prior)	43,90NOK/Pack	43,90NOK/Pack
Cheese (Norvegia 27% Skorpefri 500g)	58,9NOK	58,9NOK
Butter (Brelett 540g)	27,9NOK	27,9NOK
Banana (Dole)	25,9NOK/KG	24,9NOK/KG
Potato (loose packed)	12,9NOK/KG	12,45NOK/KG
Mandarin (loose packed)	26,9NOK/KG	39,9NOK/KG
Chocolate (60g Freia Milk Chocolate)	20,9NOK/Piece	20,9NOK/Piece
Soda (Coca Cola 1,5L)	35,9NOK/Bottle	4 for 79NOK
Frozen Pizza (Grandiosa Pepperoni 500g)	44,9NOK/Piece	44,9NOK/Piece

4.2.2 Pure online grocery retailers

Generally, the online grocery retailing has two main business models. One is that the company picks up the groceries chosen by customers and deliver them to the door or pick up point. Another type is that the companies offer dinner boxes with prepared recipe and ingredients and deliver the boxes at door. Currently, the three biggest players in pure online grocery retailing market are Kolonial, Adams matkasse and Godtlevert (Svendsen & Moland, 2017). In addition, there are other small online retailers are not mentioned in this part due to their small market share.

Kononial

The business model of Kolonial is based on the purchase of full assortment groceries. Kolonial is the biggest online grocery store in Norway that offers 5980 products online. It has been through rapid growth since 2014. The total annual turnover in 2016 was 424 million NOK. Kolonial competes over price in the low-price segments with KIWI, Bunnpris and Rema 1000. A research in 2017 shows that Kolonial's price can be 2.7% higher than KIWI with home delivery, and 0.4% cheaper than Kiwi if consumers choose click and pick. Currently, Kolonial is operating mainly in Oslo and Østland area.

The delivery cost for Kolonial varies with respect to basket size and delivery time window selected by the customers. The larger the delivery time window is, the cheaper the delivery price is. Small basket size will also lead to higher delivery cost.

Adams matkasse

Adams matkasse had 337 million NOK as annual turnover in 2016. Being established in 2012, the company had rapid growth in the past years. It delivers to around 30000 customers per week and have a national coverage with about 45 delivery zones cross the country. Adams matkasse's main activities are recipe planning, purchasing, order management and customer support. It uses third party logistic company to deliver the groceries from the central distribution centre in Oslo (Adams matkasse, 2018). The delivery time is every Monday from 16:00-22:00, and the time window is relatively long. The planning of menus starts about 6 weeks before it is delivered to their customers (Adams matkasse, 2018).

Godtlevert

Godtlevert had 390 million NOK as annual turnover in 2016, decreased from 420 million NOK in 2015. Godtlevert has similar business model as Adams matkasse. It provides online food though delivering of subscription food boxed with vegetables, fruits and assorted food items. In 2017, the two biggest food box provider Adams matkasse and Godtlevert are considering merging together. The integration of purchasing, packing and delivering can optimize the resources and make the business model more effective (Virke Enterprise Federation, 2017).

5. Questionnaire description

5.1 Description of pre-choice tasks

The purposes of designing pre-choice tasks are investigating consumers current behaviour, producing more reasonable and personalized choice situation (based on stated travel time and average expenditure per purchase). Pre-choice tasks also aim at generating consumers expectation for delivery time, time window and service fee. All of this information could be useful not only for the main choice task design, but also for further market subgroup comparisons. For instance, a consumer with experiences on online shopping, especially for grocery, will have different utility functions for alternatives compared with a non-experienced consumer. Those who usually purchase grocery in supermarkets, might show different

sensitivity levels on product price and different requirements on product range, compared to those who buy grocery in low price stores. The utility functions for the person who has available private car might be different with the one who does not have for different alternatives. More importantly, whether E-grocery can substitute shopping trips could depend on whether consumers perform dedicated shopping trips and to what extent. Besides, the transportation mode choice pertains to freight logistic and CO_2 emission.

5.2 Choice Tasks

5.2.1 Alternatives identification

At the first step, it is important to identify a universal and finite alternative list that is available to the decision makers. Theoretically, each possible alternative ought to be listed to meet the utility maximization rule. However, for getting a manageable sample size and ensuring data quality, the number of alternative has to be reduced (Hensher, et al., 2005). Within the context of the research, the alternatives are mainly classified into online and offline. As mentioned before, it is more realistic to have a status quo to avoid a forced choice in the survey. Therefore, offline or called “in store” is presented as an alternative with labelled name in the choice tasks. Besides, according to different services offered from online retailers and the popularities, E-grocery shopping are subdivided into two specific alternatives: home delivery and click-and-pick. This is to acquire more information towards on Norwegian consumers preferences. Home delivery (HD) refers to the shopping mode that products are purchased online and delivered at home or to the appointed destinations. Click-and-pick (CP) means once the order has been placed online, the goods can be collected at a pick-up point (Visser, et al., 2014).

5.2.2 Attributes identification

Consumer behaviours for grocery shopping is heterogenous and complicated. There exist various factors influencing consumers making choice on grocery shopping channels. In order to identify those factors which gives strong impacts on consumers preferences in terms of grocery purchasing channels, 3 steps are carried out as a preparation for final experiments design (see Figure 5-1). Culling from the previous works, 23 common factors are selected at the step 1. Then, through in-depth interviews and focus group method, 13 important attributes aiming at Norwegians are discussed and picked up for conducting next small-scale survey. At step 3, the results from 30 small-scale surveys present 8 attributes that get the highest concerns

(based on average scores) when people considering all three alternatives for buying grocery. Finally, 6 key attributes are identified and decided to be used for the expression of three alternatives utility functions in the questionnaire design.

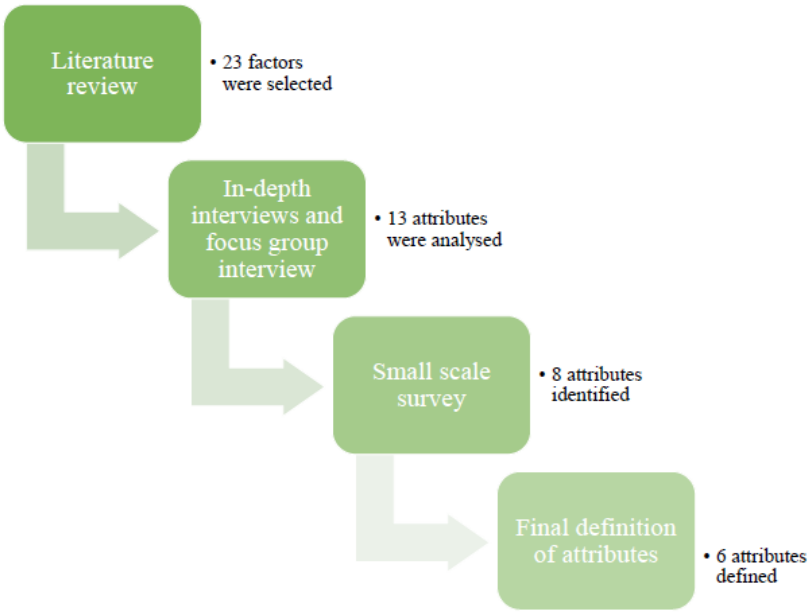

Figure 5-1. Steps in refining the attributes list

Step one: literature review

From the literature review, multitudinous studies offer related factors that consumer would concern when they have different choice channels for shopping goods. Some investigate the consumer behaviours and shopping motivation, some other discuss the advantages and disadvantage between online and offline shopping mode directly. Among them, the factors are listed and summarised to indicate the intricate nature of shopping activity and to further screen more specific attributes with respect of this research for the next step.

Prices can influence consumers channel choices. Many literatures have examined the price difference on online and offline channel. Theory suggests that online retailers often offer lower prices with respect to store-based retailers due to the low market entry and operational cost (Mokhtarian, 2004). However, this assertion is not always true. Online grocery service often comes with an additional transportation cost. In addition, due to different pricing strategy of online and offline channel, the online channel can have higher or lower price with respect to offline channel (Sotgiu & Ancarani, 2011).

Salomon and Koppelman (1988) state that shopping mode is not directing demand for consumers to do shopping activities. Instead, the pivotal role is products that they want to

purchase and this will dominate their shopping mode choices (Salomon & Koppelman, 1988). Therefore, the relevant attributes about products will be taken seriously. Consumers prefer safe and fresh products, and some of them are willing to pay more price for premium product quality. In store, the advantage is that people have ability to touch, see, smell even taste the products. Based on their own knowledge, customers can tell the product quality directly. This is very critical for online grocery shopping channel (Mokhtarian, 2004). Additionally, product range will also have impact on consumers choices. Generally, product range online will be wider than in store due to the low inventory cost such as in USA (Murphy, 2003). Nevertheless, it cannot rule out the possibility that the product range online is less than in store. For instance, in Norway, most online grocery stores have less product range than in store.

As important attributes for shopping modes, those associated with time are travel time, lead time and time window. People traveling to the physical store or the pick-up point take time. Generally, people are willing to save this time waste which could diminish their utility (Ming-Hsiung, 2009). On the other hand, online shopping with home delivery service can totally save travel time. However, online shopping requires consumers to wait for preparing the order (lead time) and deliver them to consumers' homes after the order ready for shipping (expected time window). Since, it is important to see how much consumers are willing to pay as a trade-off for travel time, lead time ad time window.

Consumers channel choice can be affected by spatial factors. Spatial factors include the location and neighbourhood characteristics associated with the residence. In this study, the spatial factors can be described as consumers distance to the city centre and their shopping accessibility (Zhen, et al., 2018). It is claimed that residents who live in urban areas are more likely to purchase online. On the other hand, some argue that people who live in areas with low shopping accessibility prefer online shopping (Zhen, et al., 2018).

The interaction between channel choice and purchase situation cannot be ignored. Under different circumstances, consumers intend to buy some products from offline channel and some other products from online channel. Among the situational variables, distance-to-store and time pressures are found more significantly affecting consumers choices (Chocarro, et al., 2013). Longer distance to store are associated with higher likelihood of online purchasing. It is also proved that consumers under higher time pressure are more likely to shop online (Chocarro, et al., 2013).

Online shopping is often associated with information service quality. Benn et al. (2015) finds that when purchasing groceries online, most people use search facilities, or browse through special offers (Benn, et al., 2015). Therefore, good website design will increase consumers chance of purchasing online. Moreover, personalization of web service is also valued by the customers. The consumers can have personalized special offers based on their previous purchasing history and receive more advertisements (Mokhtarian, 2004). It is also argued that store shopping has better information quality while online channel has better information quality (Ming-Hsiung, 2009).

Although grocery shopping sometimes differs from other types of shopping and is seemingly less considered as a social activity, social variables are found to play a role in channel choice. Going to store can be deliberately chosen to fulfil people's social desires. Moreover, retailing stores are increasingly combining entertainment with shopping. Grocery stores can provide entertaining atmosphere for customers to enjoy the shopping process (Mokhtarian, 2004).

Other factors such as basket size, marketing effort and movement are also discussed in literatures. Suel and Polak (2017) find the positive association between basket size and online shopping probability. Valentini et al. (2011) argue that when consumers are firstly introduced to a new purchasing channel, they are more responsive to marketing effort. Heavy advertisement will affect their channel choice. Need for movement is discussed by Mokhtarian in 2004. It is claimed that travel has a positive utility and are sometimes needed for its own sake (Mokhtarian, 2004).

Step two: In-depth interview and focus group interview

In order to get comprehensive understandings of the subject, especially on Norwegian consumers, two semi-structured in-depth interviews and one focus group interview were conducted.

Interviewee one is a heavy online grocery shopper who purchases most of the monthly groceries online. The main factor made him shift from traditional to online grocery shopping is convenience. He buys grocery once a month with big basket size which contains mostly frozen food and beverages. In store shopping is combined to purchase small lot fresh food. He uses the spare time to plan the grocery list and place the order 1-3 days before expected delivery time. The interviewee addresses that the product prices from online channel do not differ much from store, and the additional service cost is acceptable. In fact, E-grocery helps him to save

money because it is easier to plan and can avoid impulsive buying. When it comes to delivery time, the interviewee states that he *"...does not mind how long the lead time is, as long as it arrives before Friday"*. However, it is pointed out that the interviewee does not prefer the delivery time window being longer than 2 hours. In terms of website design and service, the interviewee emphasizes that he values good online service when choosing which retailer to buy from. He shifted from one E-retailer to another mainly due to the poor website design.

Interviewee two is a light online grocery shopper which purchases prepared food box once a month. The main reason drives him to choose online grocery is that he likes to try the new online channel and the business concept of food box. The interviewee is highly responsive to marketing efforts. When he receives information about special offers, it is very likely for him to click through the advertisement and purchase goods online. The interviewee does not compare price from online and offline channels. Moreover, he is willing to pay up to 100 NOK to get groceries delivered at door. Nevertheless, the online channel is used as an additional purchase mode and does not substitute in store shopping. The interviewee still prefers to go to stores because he likes to see then feel the groceries, and he can instantly get the groceries. The stores also have wider selection of goods, according to him. In terms of delivery, the interviewee has high acceptance on lead time, which can vary from one day to several days. The interviewee values the payment safety and personal information safety online. These are the aversion factors for him to choose online channel. Regarding the grocery product online, the interviewee is generally satisfied with the qualities. However, he is loyal to some certain brands, which can be only found in stores.

In the focus group discussion, 5 local residents are selected. The interviewees give their opinions on existing in-store shopping experiences, as well as anticipation to online grocery services. Generally, people like in-store shopping due to the fact that they can look and feel the things they purchase. They agree that they have convenient connection to stores and shopping groceries in store requires no planning. On the other hand, online grocery can be attractive due to the fact that it is convenient to get groceries delivered at door. Online grocery saves time and one can avoid the grocery shopping trip and queue. It is also mentioned that it is easier to plan, and one can avoid impulsive shopping. People are found to consider the important attributes, such as purchase cost, extra service cost, delivery time window and order lead time, product quality and website design. Additionally, it is worth mentioning that the attraction and aversion factors are different between genders. Males try to avoid long shopping time and queue in store, whereas females are more like to spend time in store and have a tangible feeling of the groceries.

Based on the in-depth interviews and focus group interview, the attraction and aversion factors for in store shopping and online shopping are summarized in Table 5-1.

Table 5-1. Attraction and aversion factors of each channel

Existing grocery shopping modes	Attraction factors	Aversion factors
In-store shopping	- One can see and feel the groceries - Good customer services - Easy to collect product information - Wider product range - Relax and entertainment	- Queue - Bad store layout - Dedicated shopping trip takes time - Bad weather - Limited store opening hours
Online shopping (Including home delivery and click-and-pick)	- Discount - Convenience in terms of time and place - Responsive customer service - Avoid shopping trip to stores - Easier to plan - Avoid impulsive shopping - Good website design - Personalized online service	- Not flexible when replacing the items - Extra cost - Needs extra planning - Long waiting hours - Concern about quality

Factors affecting consumer channels choice can be categorized into different types. The factors can be channel attributes, social influence, individual differences and situational factors (Valentini, et al., 2011). In this study, only channel attributes are focused in order to derive the economical equations for the research objective. Based on these considerations, 13 attributes are selected from the in-depth interview and focus groups interview:

1. Product price (NOK): How much the cost of grocery products differs from the stores.

2. Product range (%): The percentage of available grocery online with respect to the stores.

3. Service cost (NOK): The extra cost for order preparing and (or) delivery fee.

4. Travel time (minutes): The time spend to reach the store and (or) pick up point for dedicated grocery shopping trip.

5. Product quality (days): The number of days before the best of the date.

6. Shopping time (minutes): The time needed to perform a grocery shopping in store or online.

7. Store opening hours (hours): The amount of business hours of a grocery store.

8. Time window (minutes): The range of Expected Time of Arrival.

9. Lead time (hours): The time between placing orders and the orders can be delivered.

10. Marketing efforts (No.): The number of E-grocery discount advertisement received per week differs from in store advertisements.

11. Easy to use website (No.): The number of steps needed to place a grocery order online.

12. On time delivery (%): The rate of receiving the order within the expected time window.

13. Delivery accuracy (%): The rate of receiving correct products with right amount.

Step three: Small-scale survey

Based on the selection of literature review and interviews, 13 channel attributes were selected to conduct a small-scale survey. 30 respondents are asked to select the attributes that are most important to them when selecting a grocery purchase channel. Moreover, respondents are required to rate how much or how little these attributes affect them by allocating points to each attribute. The small-scale survey is administered in a purposely designated area from 17th to 20th February 2018. After collecting the data, attributes are ranked by the frequency they are chosen, as well as their average scores given by the respondents. The results of attributes are summarized in Table 5-2. The questionnaire used for small scale survey is attached in Appendix III.

Table 5-2. Attributes selected from the small-scale survey

Channel	Attributes
In store	Product price (NOK)
	Travel time (minutes)
	Product range (%)
	Marketing effort(No.)
	Product quality (days)
Home delivery	Product price (NOK)
	Service cost (NOK)
	Product quality (days)
	Time window (minutes)
	On time delivery (%)
Click and pick	Product price (NOK)
	Service cost (NOK)
	Travel time (minutes)
	Time window (minutes)
	Product quality (days)

According to the results, eight attributes are selected from the small-scale survey, which are presented in Table 5-3. Among the eight attributes, marketing effort and product quality are taken out from the attributes list. Admittedly, those two attributes are important for consumers. However, it is hard to quantify marketing effort and product quality in a SP questionnaire. Taking these two attributes in choice tasks will be unrealistic. Furthermore, although lead time is not considered significantly important from interviews and surveys, it is heavily addressed in many literatures (Visser, et al., 2014) (Adrita & Tanzina Shahjahan, 2016) (Punakivi, 2001). Therefore, lead time will be taken into consideration in the final SP design. Table 5-3 sums up the factors and attributes selected from all three steps.

Table 5-3. The process for key attributes identification

Step 1: **Factors concluded from literature review**	**Step 2:** **Factors analysed from in-depth interview**	**Step 3:** **Factors selected from small survey**	**Step 4:** **Final attributes with used for SP questionnaires**
Product price	Product price	Product price	Product price
Transportation cost	Product range	Product quality	Service cost
Pick-up cost	Service cost	Service cost	Product range
Product quality	Travel time	Travel time	Travel time
Product range	Product quality	Time window	Time window
Travel time	Shopping time	Product range	Lead time
Lead time	Store opening hours	Marketing effort	
On time delivery	Time window	On time delivery	
Shopping time	Lead time		
Store opening hours	Marketing efforts		
Distance to the city	Easy to use website		
Shopping accessibility	On time delivery		
Distance to the store	Delivery accuracy		
Time pressure			
Online payment security			
Easy to use web site			

Information availability			
Personalization			
Social interaction			
Entertainment			
Basket size			
Marketing effort			
Movement			

5.2.3 Attributes level identification

The design of attributes levels is based on two principles. Firstly, the attribute levels need to cover a sufficient range so as to include likely boundary value between attributes. Secondly, the attributes levels should be close to each other to allow a sufficiently accurate estimate of the boundary values (Sanko, 2001).

Product Price (PP)

The pure online grocers in Norway claim that it is cheaper to purchase grocery from online channel than from offline channel (Kolonial.no, 2016), whereas the multi-channel retailers claim that the PP online is identical with the product price in store (SPAR, 2018). However, after a price investigation of both offline and online channels, it is found that differences in price exist between offline and online channels. For example, a 1.5L Coca Cola bottle cost 35.9 NOK in SPAR online store, 28.2 NOK in Kolonial online store, and 4 bottles for 79 NOK (Single price 19.9 NOK per bottle) in SPAR supermarket. The price strategy is different in offline and online channels.

The experiment aims to investigate whether the PP has impacts on consumers purchasing channel choice. In order to cover the possible price ranges and present sufficient sensitivity, there will be three levels of this alternative. The stated average price per purchase from pre-interview will be used to indicate the PP for in store alternative, with variation of decreasing

10% and increasing 10% respectively.

Travel Time (TT)

The attribute of travel time contributes both in store utility function and click and pick utility function. The interaction effects of this attribute between two functions have to be concerned. TT represents how much time does a consumer spend for a round-trip between home and store. In reality, consumers could choose pick their groceries in store (drive in) or in other specified points (drive out) such as gas station. Therefore, if they choose drive in, then the level of TT is the same as going to store, otherwise, the level of TT is expected to be less than the time traveling to store. The TT stated by interviewee in the pre-interview is a stated level. In order to investigate how reducing TT affects consumer choice on purchasing channel, and to have accurate estimation of value boundaries, two other additional levels will be tested. Hypothetically, if the TT were reduced to 75% and 50%, there could be a change in consumers channel choice.

Time Window (TW)

Time Window is the Expected Time Arrival (ETA) window. In the current online grocery market, the TW varies from 90 minutes (Kolonial Express Delivery) to 6 hours (Adams Matkasse). A normal TW for NorgesGruppen's multi-channel grocery retailers is around 2 hours (SPAR, MENY, Joker). Therefore, the first TW level adopted is 120 minutes as it represents the most common TW in the market.

Through in-depth interviews and focus group, it is discovered that the consumers prefer shorter waiting time window. This is connected with the delivery punctuality. Both pure online grocers and multi-channel grocers are working towards better logistic solution for shorter delivery time (Kolonial.no, 2016). Kolonial, for example, is working on the last mile delivery solution with the help of drones. They claim it can reduce delivery time window as drones do not have congestion problem (Kolonial.no, 2016). It is reasonable to assume that, in the future, the ETA window can be reduced to 60 minutes and 30 minutes. The survey can estimate whether higher logistical performance and shorter waiting time could influence consumers grocery channel choices (Kolonial.no, 2016).

Product Range (PR)

The product range is a fixed level for the in-store alternative, as it is treated as a comparison

between online and offline alternatives. According to investigation, in Norway, usually the online channel has a narrower selection of products than offline grocery retailers. Kolonial.no sells 5980 products on their website. SPAR online store has around 7000 products. An estimation of PR in a normal SPAR supermarket is made by a store manager from 7000 products to 8000 products. In the future, as the online grocery sector grows, it is possible that online grocery retailers will have wider PR. However, it is highly unlikely that the Norwegian online grocery PR will exceed offline PR in the near future. Due to insufficient data, it is not possible to calculate the current percentage of online PR with respect to the stores. Therefore, an estimation needs to be made in order to test consumers acceptance on online PR. 150% and 50% can be reasonable estimations to test the boundary values of this attribute.

Service Cost (SC)

Service Cost is the additional cost attached to the online channel. The levels of SC are different between home delivery and click and pick alternatives. Currently, the services fee for home delivery in Norway varies from 0 NOK to 199 NOK. However, 199 NOK is for express delivery and not commonly used. Based on the basket size, the service fee for click and pick usually is free when the purchasing cost is over 1000 NOK, whereas for home delivery, the average cost is 65 NOK. If the purchasing cost is less than 1000 NOK, the average price will be charged around 45 NOK for click and pick and 100 NOK for home delivery (more detail please see Appendix 2).

According to the survey in 2017, 66% of Norwegians think free shipping is important for them to shopping online (Postnord, 2016). The rapid development of technology will improve the logistic planning to reduce transportation cost. Therefore, it is possible in the future that the SC for both alternatives can be zero. The levels of SC for home delivery will be 0 NOK, 60 NOK, and 100 NOK. For click and pick alternative, two levels are able to cover the possible boundary ranges. The levels will be defined as close to reality as possible, which means it has to be lower than home delivery cost. Hence, the levels of SC will be 0 NOK and 50 NOK.

Lead Time (LT)

Lead time is the duration between the time when the order is placed and the time that orders are ready to be sent. It is a way to measure how long it will take for retailers to prepare the order. According to the in-depth interviews and the results of small-scale survey, LT is less sensitive than TW, so the range of LT might not be tight. In order to cover the whole range of LT and

investigate how much the differences could influence consumers channel choice, the range of estimated levels of LT will be wide.

In the current Norwegian online grocery market, if the order is placed before 12 clock, the order can be sent or picked up in the late afternoon, which implies that the prepare time would be around 6 hours, e.g. MENY, Kolonial, SPAR. Based on this estimation, the levels of LT can be defined as 1 hour, 6 hours (possibly sending the order in the same day), and 12 hours (possibly sending the orders in the next day). The levels have no difference between home delivery and click and pick alternatives for this attribute.

Based on the discussion above, Table 5-4 summarises the attributes and attribute levels for all three alternatives.

Table 5-4. Summary for the alternatives with attributes and attribute levels

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

5.2.4 Model Specification

After the alternatives, attributes and levels are decided, it is possible to specify the model. As discussed in section 2.4.3, the model is based on the assumption that respondents aim to maximize their utility function. The utility model consists of two parts: deterministic and random component. According to equation (2.1), the utility functions used in this choice experiment are formed as follows:

$$U_{store} = V_{store} + \varepsilon_{store} \quad (5.1)$$

$$U_{hd} = V_{hd} + \varepsilon_{hd} \quad (5.2)$$

$$U_{cp} = V_{cp} + \varepsilon_{cp} \quad (5.3)$$

The deterministic parts of the three equations can be expressed with their attributes and weighting parameters, as written below:

$$V_{store} = \beta_{0store} + \beta_{1store}PP_{store} + \beta_{2store}TT_{store} + \beta_{3store}PR_{store} \quad (5.4)$$

$$V_{hd} = \beta_{0hd} + \beta_{1hd}PP_{hd} + \beta_{2hd}SC\_HD + \beta_{3hd}TW_{hd} + \beta_{4hd}PR_{hd} + \beta_{5hd}LT_{hd} \quad (5.5)$$

$$V_{cp} = \beta_{0cp} + \beta_{1cp}PP_{cp} + \beta_{2cp}TT_{cp} + \beta_{3cp}SC\_CP + \beta_{4cp}PR_{cp} + \beta_{5hd}LT_{cp} \quad (5.6)$$

5.3 Description of post-choice tasks

Post-choice task contains two parts. In the post interview part, the general attitudinal data about E-grocery are collected from respondents based on hypothetical scenarios. This information can be used to identify the acceptance trend of E-grocery in the near future. In socio demographic part, the background information is asked in order to find out the goodness of sample coverage and the differences between the sample subgroups. For instance, gender, number of family members, age range and income range. This information allows one to determine whether the sample group is reaching target audience. Moreover, if the sample size is big enough, the socio demographic information enables one to differentiate the sub-groups. The utility function of females can be different from the utility function of males, for example. The SP questionnaire is attached in Appendix IV.

6. Data description

As mentioned before, the data collected from focus group, semi structured in-depth interview and small-scale questionnaire are dedicated for the next step of experimental design. Therefore, this section will only focus on the main results description from SP survey rather. The other data collected from supportive methods are mentioned in the previous sections.

The SP survey are implemented through two fashions: social media based and face to face interview. There are 51 out of 231 questionnaires are sent through Emails from company yellow page, LinkedIn and Facebook. The rest of 180 questionnaire are conducted by face to face interview randomly. Due to the complexity and time consuming, only 22 valid questionnaires

based on the social media based are finished completely with consistent responses. Therefore, there are 202 respondents in total with 1212 choice tasks. 4 choice tasks are invalid due to lack of choice. Based on the questionnaire, a descriptive statistical analysis for 202 samples are summarized in the following parts.

The sample has a fairly good coverage based on gender, age, income level and resident location. There are 104 females and 98 males participate in the survey. The age ranges from 16 to above. The largest portion in the sample is 25-34 years old, as presented in the Figure 6-1. The income level ranges from less than 7500 NOK to more than 75000 NOK classified by Norwegian which almost covers all employment status including students. Figure 6-2 shows the proportion of samples in different income levels, and the data are distributed almost evenly. Although there is no specific question about the resident location in the survey, more than half of questionnaires are conducted in the Oslo airport, and people varies from different cities. The others are interviewed in school, shopping centre, library, hotel and on the ferry.

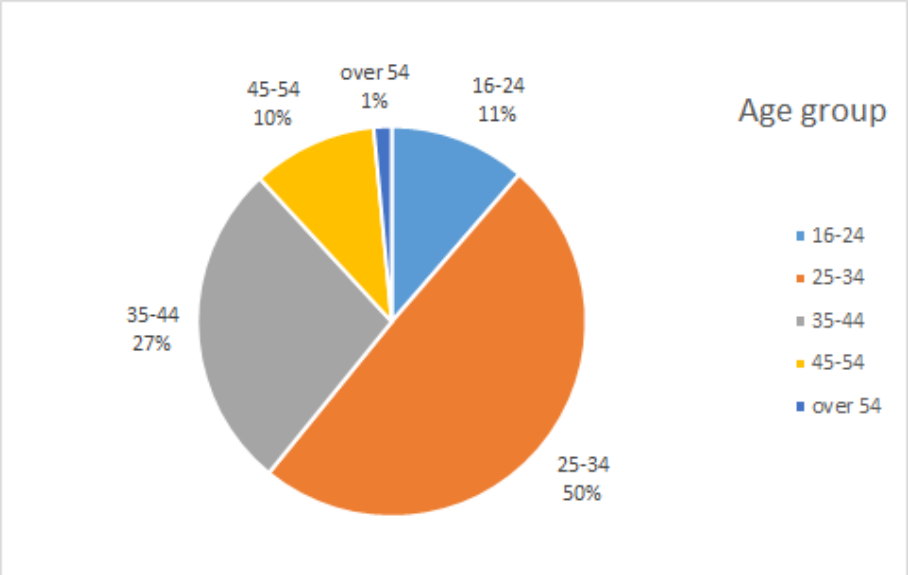

Figure 6-1. Distribution of age group in the sample

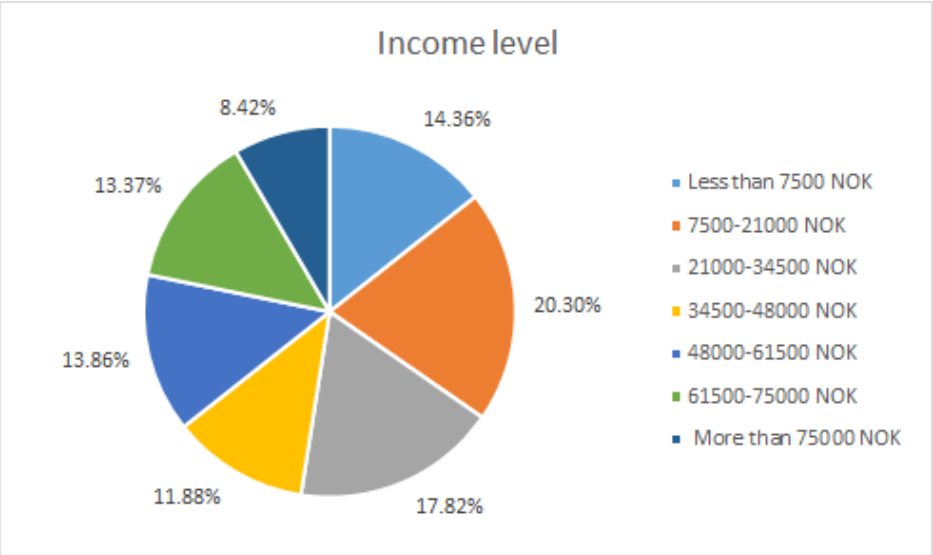

Figure 6-2. Distribution of income level in the sample

Among the 202 respondents, 167 are the one who are usually purchasing groceries for the household which makes the survey more meaningful because they are more representative in the household. Interestingly, 81 out of 167 respondents are males who are the one usually purchasing grocery for the family. Moreover, more than half of respondents are live alone or with one person. 15% people live with 2 family members, and 10% live with 3 family members. The rest 11% of respondents have more than 3 people living together (see Figure 6-3).

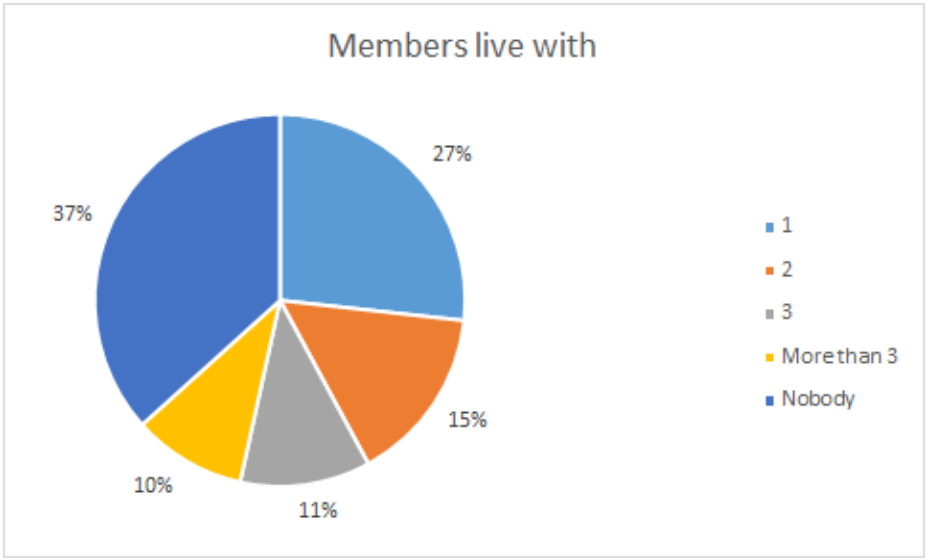

Figure 6-3. Distribution of the family members live within the sample

In the survey, 195 respondents have experience in online shopping. 67% of total respondents are aware of the possibility to buy grocery online at the place where they live in. 102 respondents state they have considered purchasing grocery online, but only 25% people did it before. Therefore, the reasons behind the gaps between consideration and actual action might

need to be explored. According to the survey, usually respondents prefer to buy grocery in low price stores such as Bunnpris, Rema 1000 and Extra and Supermarket like SPAR, MENY and Coop Mega, accounting for 41% and 48% respectively (see Figure 6-4).

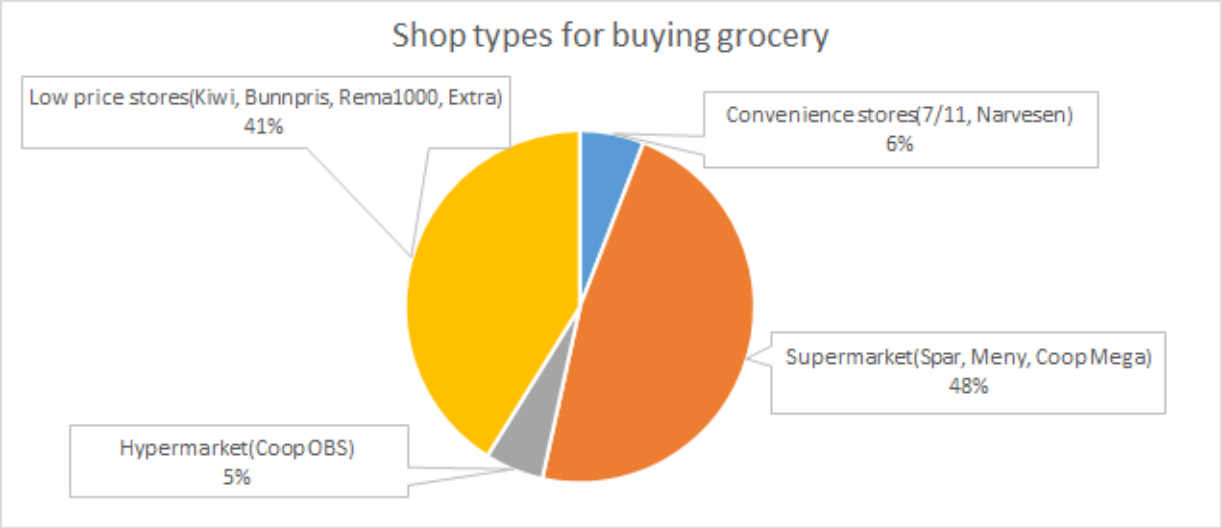

Figure 6-4. Distribution of store types for buying grocery in the sample

There are 131 interviewers have available private cares compared with 71 do not have their own cars. According to the Figure 6-5, there are 104 consumers prefer private car as their main transportation mode for grocery shopping trips, followed by the choice of on foot with 67 answers. Among the 202 answers, 147 respondents usually perform dedicated trips for buying grocery and 79 of 147 respondents select using private car as their transportation mode for shopping grocery. Due to the concern of CO_2 emission and the relationship with transportation policy implementation, the attitude towards CO_2 emission is tested by asking respondents the willingness to change their purchasing behaviour from in store to online to reduce CO_2 emission. 62 people do not care about this issue which includes 56% of them shopping by their own private cars and 26% of them walking to the stores.

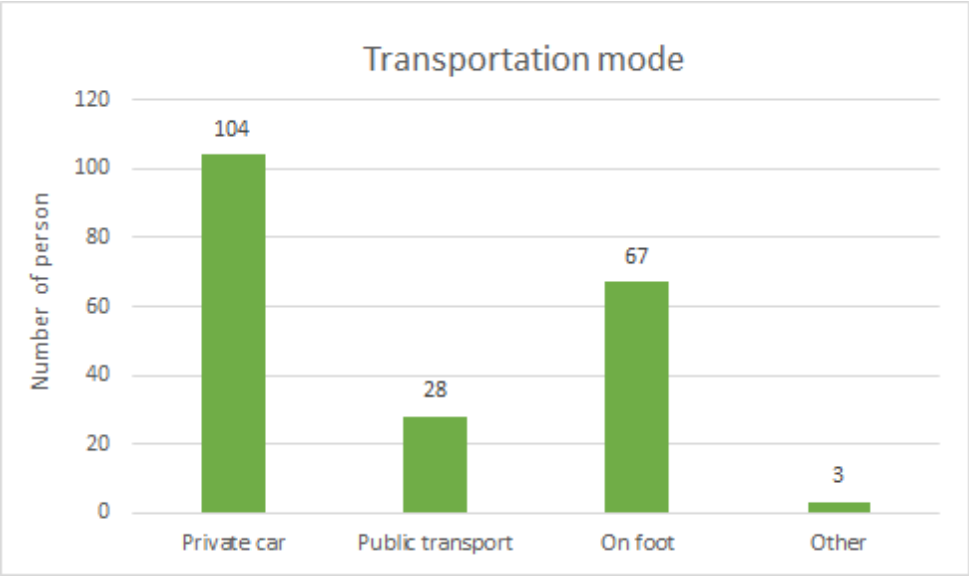

Figure 6-5. Distribution of transportation modes for grocery shopping trips

According to the sample data, the range of travel time for a round trip are wide from 1 minute to 120 minutes. The wide range covers more variables and will be more representative for the population. For example, the attributes affecting the person who lives close to stores might be different with the person who spends 120 minutes traveling to stores. Consequently, it will have effects on the results of payment range for avoiding this trip. Therefore, the willingness to pay for avoiding this trip is from 0 NOK to 400 NOK in the 202 samples. For the expected waiting time from placing order to receive the grocery, the most frequent answer is 24 hours which are considered by 84 respondents. The most popular acceptable time window is 2 hours answered by 88 respondents.

For the product type and basket size, the most popular product category is eggs, milk and cheese which is selected by 95% of respondents as their typical grocery category. Fruit and vegetables, meat and seafood, both two categories are placed as the second selected by 91% of respondents. 82% of interviewers state that they are frequently purchasing bread, flour and bakery products (see Figure6-6). Clearly, most typical products categories are associated with experience goods.

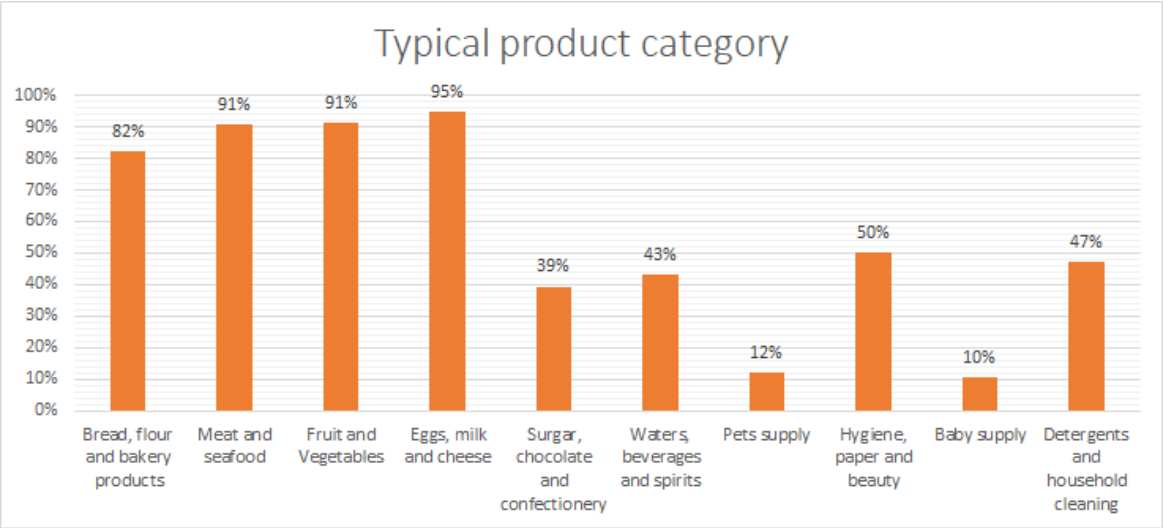

Figure 6-6. The frequently purchased grocery types

The questionnaire asks about respondents' current grocery purchasing frequency in pre-interview, and their hypothetical grocery shopping frequency if E-grocery meets their needs perfectly in the future. This is to test respondents' attitude towards E-grocery if no other marketing conditions are specified. If one respondent will use E-grocery more frequently in the future, he or she is defined to have positive attitude towards E-grocery. If the respondent shows no difference between current and future shopping frequency, he or she is found to be neutral towards E-grocery. If one respondent uses less E-grocery in the future, he or she is defined to have negative attitude towards E-grocery. After calculation, 84% of respondents are found to be in favour of E-grocery. 14% of respondents are neutral while 2% of respondents show negative attitudes towards E-grocery (see Figure 6-7).

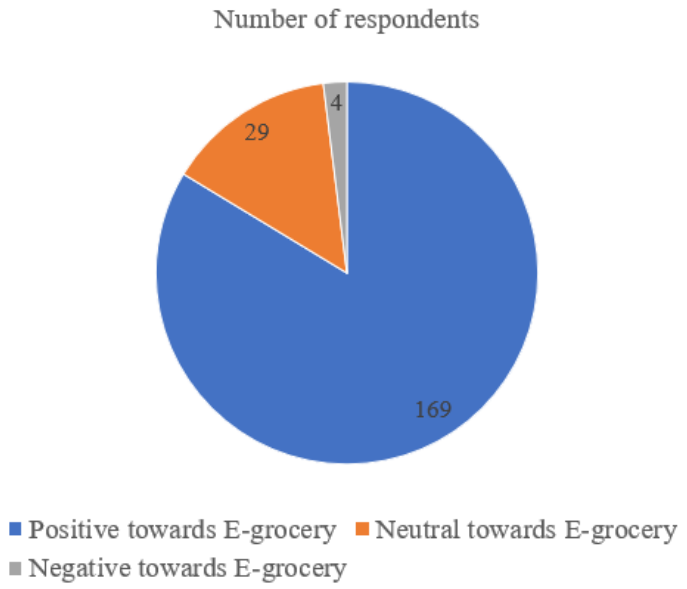

Figure 6-7. Respondents' general attitudes towards E-grocery

7. Econometric results

In this section, the econometric results from SP data samples are interpreted. The section starts from testing the goodness of MNL model fit with observations statistically as well as the model significance. Then the following part explains the output of parameter estimations for different utility functions in terms of sign, significance, and magnitude. The willingness to pay for different attributes and different consumer subgroups will be discussed, especially for the value of time. The overall output generated by NLOGIT version 6, and the Table 7-1 presents general output for the choice models.

Table 7-1. The general output generated by NLOGIT

```
--------------------------------------------------------------------------------
Discrete choice (multinomial logit) model
Dependent variable                Choice
Log likelihood function       -961.14511
Estimation based on N =   1208, K =   9
Inf.Cr.AIC  =   1940.3 AIC/N =    1.606
-------------------------------------
           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]          =    545.98188
Prob [ chi squared > value ] =   .00000
Response data are given as ind. choices
Number of obs.=  1212, skipped    4 obs
--------+-----------------------------------------------------------------------
        |                 Standard            Prob.      95% Confidence
   ANS_1|  Coefficient       Error       z    |z|>Z*         Interval
--------+-----------------------------------------------------------------------
      PP|    -.00920***      .00141    -6.54  .0000     -.01196   -.00645
   SC_HD|    -.01809***      .00224    -8.09  .0000     -.02248   -.01371
      TW|    -.00437*       .00250    -1.75  .0800     -.00926    .00052
      PR|     .00670***     .00163     4.11  .0000      .00351    .00990
      LT|    -.07266***     .01481    -4.91  .0000     -.10168   -.04364
  ASC_CP|    -.77234***     .20751    -3.72  .0002    -1.17905   -.36563
      TT|    -.02967***     .00487    -6.09  .0000     -.03921   -.02012
   SC_CP|    -.01738***     .00342    -5.08  .0000     -.02408   -.01068
  ASC_SM|    -.15848        .20125     -.79  .4310     -.55291    .23596
--------+-----------------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
--------------------------------------------------------------------------------
```

7.1 Goodness of model fit

When interpreting the econometrics result, the first thing is to test the goodness-of-fit. It is an indicator to evaluate the adaption of collected data and the regression model. In another word, the goodness-of-fit is a way to describe how well the statistical model fits a set of observations (Yazici, et al., 2007). Although the utility function itself is linear, the probability outputted from

a discrete choice model (MNL model) will be nonlinear, so the statistic to R-squared does not exist. In this case study, the pseduo-R^2 will be used to test the goodness-of-fit for the model by the following equation (7.1) rather than R^2.

$$peudo\ R^2 = 1 - \frac{LL_{Estimated\ model}}{LL_{Base\ model}} \quad (7.1)$$

Domencich & McFadden (1975) claim that there is a positive relationship between pseudo-R^2 and R^2. The pseudo-R^2 looks like R^2 with similar range from 0 to 1. The higher the value of pseduo-R^2 is, the better the model fits the observations and covers more variables. Hensher, et al., (2005) suggest that when the value range of pseduo-R^2 is between 0.3-0.4, it can be assumed as a value range of R^2 from 0.6 to 0.8 for a linear regression model which represents a decent model fit (Hensher, et al., 2005).

Before testing the goodness of model fit, it is essential to calculate maximum likelihood estimation (MLE), which is robustness and has ability to deal with complex data (Hensher, et al., 2005). MLE is a method to estimate the parameters in a statistic model. The value of MLE is the value of parameter that can maximize the likelihood function, so the choice probabilities of chosen alternatives are maximized, given the observations. Since log function is an increasing function, the maxima of the likelihood and log likelihood coincide, also calculating log likelihood is more convenience for analyst (Hensher, et al., 2005). The equation of log likelihood (LL) is shown in (7.2)

$$LL_{NS} = \sum_{n=1}^{N} \sum_{s \in S_n} \sum_{j \in J_{ns}} y_{nsj}\ \ln(P_{nsj}) \quad (7.2)$$

where

N represents total number of respondents;

J represents alternatives;

S represents choice tasks;

Traditionally, there are two types of LL base models could be used to compare with the LL estimated model. One is the LL function of the model fitted independently of any information contained within the data, which is called null model. This base comparison model is estimated when the choice of each alternative to be selected are equal. It ignores any other true choice information. The other base model is the LL function of the model fitted using only information

of the market shares within the data set, which is called constants only model (Hensher, et al., 2005). The constant value is also called alternative-specific constant (ASC), reflecting the average value of variables that have not be measured. When the utility function for an alternative is estimated without other design attributes and just only ASC, then ASC represents the average utility for that alternative (Hensher, et al., 2005). In short, the first type of base model (type 1) is under the assumption of equal market share, whereas the second type (type 2) model is based on the actual market share within the data.

The utility model employing only ASC can represent the average utilities for the alternative. From Table7-2, the alternative 1 (Alt.1) is for home delivery (HD) and alternative 2 (Alt.2) means click and pick (CP). The log likelihood of type 2 base model is -1234.136. The coefficients for both ASCs are negative of each alternative. Therefore, consumers prefer in store which the utility level is 0, and the second one is HD followed by CP alternative. The utility functions are shown below:

$$V_{store} = 0$$

$$V_{hd} = -0.63422$$

$$V_{cp} = -0.91789$$

$$LL_{Base\ model\ type\ 2} = -1234.13605$$

Table 7-2. The output constant only model

```
------------------------------------------------------------------------------
Discrete choice (multinomial logit) model
Dependent variable                Choice
Log likelihood function     -1234.13605
Estimation based on N =   1208, K =   2
Inf.Cr.AIC  =   2472.3 AIC/N =    2.047
--------------------------------------
           Log likelihood R-sqrd R2Adj
ASCs  only  model must be fit separately
              Use NLOGIT ;...;RHS=ONE$
Note: R-sqrd = 1 - logL/Logl(constants)
--------------------------------------
Response data are given as ind. choices
Number of obs.=  1212, skipped    4 obs
--------+---------------------------------------------------------------------
        |                 Standard            Prob.      95% Confidence
   ANS_1|  Coefficient       Error       z    |z|>Z*         Interval
--------+---------------------------------------------------------------------
 A_Alt.1|    -.63422***      .06789    -9.34  .0000     -.76728   -.50115
 A_Alt.2|    -.91789***      .07482   -12.27  .0000    -1.06453   -.77125
--------+---------------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
------------------------------------------------------------------------------
```

According to the output in Table 7-1, the estimated log likelihood (LL) is -961.14511, given the observations. For LL of base model type 1, the probability of random selecting each specific alternative is 1/3. With 1208 observations (6 tasks, 202 interviews but 4 bad observations), the value of LL base model type 1 can be calculated by the equation (7.2), which is -1327.12364. The pseduo-R^2 is determined as around 0.28 which is relatively high. If the value of pseduo-R^2 is tested by LL base model type 2, it still significant statistically with slightly lower number around 0.22. Therefore, it is proved that the estimated model represents a decent model fit.

$$LL_{Estimated\ model} = -961.14511$$

$$LL_{Base\ model\ type\ 1} = (202 \times 6 - 4) \times \ln\left(\frac{1}{3}\right) = -1327.12364$$

$$peudo\ R^2 = 1 - \frac{LL_{Estimated\ model}}{LL_{Base\ model\ type\ 1}} = 1 - \frac{-961.14511}{-1327.12364} = 0.27577 \approx 0.28$$

$$peudo\ R^2 = 1 - \frac{LL_{Estimated\ model}}{LL_{Base\ model\ type\ 2}} = 1 - \frac{-961.14511}{-1234.13605} = 0.2212 \approx 0.22$$

7.2 Determining overall model significant

The next step is to determine whether the LL of the estimated model is statistically significant improvement by comparing the LL of an estimated model against the LL of its base model. If the LL of estimated model is thought to have a statistical improvement on the LL of base model, then the output shows the model is statistically significant overall. The test of comparison is called LL ratio-test which is associated with the value of Chi-square. According to the equation (7.3), if the value of -2LL exceeds the value of Chi-square represented as X^2, then the null hypothesis which means the estimated model is no better than the base model has to be rejected.

$$-2(LL_{Estimated\ model} - LL_{Base\ model})$$

$$\sim X^2_{(number\ of\ new\ parameters\ estimated\ in\ the\ estimated\ model)} \qquad (7.3)$$

The LL ratio-test is run by the NLOGIT automatically, and the base model type 1 is performed in the test by using equal market shares (base model type 1) (Hensher, et al., 2005). Therefore, according to the Table 7-1, the critical of Chi-square value is 545.98188 and the p-value is 0.000. Clearly, the p-value is less than the significant level (α=0.05), so the null hypothesis that the estimated model is no better than the related base model is rejected. Therefore, there is

strong evidence to show that the estimated model is statistically better than the related base model.

7.3 Parameter estimation

For an estimated model, many variations are added to explain the dependent variable within the sampled data. The weight of each variable towards the choice of alternative are different, which performed by the attached coefficients. According to the Table 7-1, the obtained values of coefficients are negative except the attribute of product range (PR), which is consistent with the expectation before getting the results. For example, the longer lead time, the lower utility level achieved by consumers.

Moreover, an important property of the estimated parameter is the significance. To determine the significance for each parameter, Wald-statistic test can be used as shown in equation (7.4) (Hensher, et al., 2005). If the absolute value of Wald-statistic test exceeds the critical Wald-value which is 1.96, then the null hypothesis can be rejected, so the parameter does not equal to zero and the explanatory variable is statistically significant to the choice. The same conclusion can be draw by comparing p-value with determined significant level ($\alpha = 0.05$). From the output, only the coefficient of ASC_SM is not significant, which indicates that the null hypothesis cannot be rejected. Due to the utility level is not an absolute value, so there are J-1 ASCs (alternative specific constants) for any choice model. It is meaningful only when considering relative to that utility for other alternatives (Hensher, et al., 2005). Therefore, the insignificant parameter of ASC_SM means that there might not exist difference for the preference when consumers considering grocery channel choice between HD and in store. However, ASC_SM will not be taken out from the model because it might not be significant for this small sample size but might be significant to the bigger sample or even the whole population.

$$Wald = \frac{\beta_i}{standard\ error_i} \tag{7.4}$$

The magnitude presents the level of impact of each attribute on the utility. The important thing is that the value of coefficient cannot simply be compared due to two reasons that there exists lambda combined with beta, and the units for different attributes attached betas are different.

According to the Table 7-1, the information from the output can be used to write out the utility functions of the deterministic parts for each alternative. To confirm the earlier model specification, they yield the following estimated utility functions:

$$V_{store} = -0.15848 - 0.00920PP_{store} - 0.02967TT_{store} + 0.00670PR_{store}$$

$$V_{hd} = -0.00920PP_{hd} - 0.01809SC\_HD - 0.00437TW_{hd} + 0.00670PR_{hd} - 0.07266LT_{hd}$$

$$V_{cp} = -0.77234 - 0.00920PP_{cp} - 0.02967TT_{cp} - 0.01738SC\_CP + 0.00670PR_{cp} - 0.07266LT_{cp}$$

As mentioned before, ASCs represent average influences of unobserved factors on the choice decisions for each estimated alternative. When holding everything else constant and only considering ASCs, ASCs also can be represented as an estimated current market share of different choices, given collected sample data (Luviere, et al., 2010). However, it is unrealistic, because market share has to be calculated under the specific situation with specific conditions. Therefore, different market share or choice performed from MNL models would be more realistic with different changing factors.

7.4 Willingness to pay

Generally, the measure of willingness to pay (WTP) is designed to obtain the amount of money that individuals are willing to pay for getting some benefit. The measure of WTP endows a monetary unit to the attribute by comparing two estimated parameters and holding all else constant, shown in the equation (7.5). As a financial indictor, one important measure of WTP is to get value of time (Hensher, et al., 2005). For instance, the amount of money that individuals are willing to pay for saving a unit of time spending on travel time is the value of travel time. Thus, WTP could be useful for the following part of policy implementation. In order to ensuring the measure of WTP is meaningful, two comparing attributes have to be statistically significant (Hensher, et al., 2005).

According to the Table 7-1, the results of different WTP considering product price and service cost are calculated through the equation (7.5) and are represented in the Table 7-3. Clearly, PR has positive impact on different types of costs, whereas different types of time generate negative effect on cost, which is consistent with the expectation. Consumers are willing to pay more for wider product range and shorter travel time, time window or lead time. Taking travel time as an example, 1 minute TT equals 3.225 NOK product price, and 1.707 NOK service cost for CP

choice. It implies that if the person takes long time to travel for shopping grocery, he would like to pay higher product price rather than extra service cost to save his travel time. In the data description part, it claims that the most popular acceptable time window is 2 hours, given the samples, so generally, the value of time window for 2 hours equals 29 NOK ($0.242 \times 60 \times 2$). The value of lead time can be estimated in 0.07 NOK/minute averagely, and the value of lead time for one hour could be 4.2 NOK. Therefore, consumers are willing to pay for the service cost of HD is around 33 NOK.

$$WTP_k = -\frac{\frac{\partial V_{nsj}}{\partial x_k}}{\frac{\partial V_{nsj}}{\partial x_c}} = -\frac{\beta_k}{\beta_c} \tag{7.5}$$

Table 7-3. Different values of WTP

WTP	Values of WTP
WTP_1 LT:PP	-0.132 (NOK/minute)
WTP_2 PR:PP	0.728
WTP_3 TT:PP	-3.225 (NOK/minute)
WTP_4 TW:PP	-0.475 (NOK/minute)
WTP_5 LT:SC_HD	-0.067 (NOK/minute)
WTP_6 PR:SC_HD	0.370
WTP_7 TW:SC_HD	-0.242 (NOK/minute)
WTP_8 LT:SC_CP	-0.070 (NOK/minute)
WTP_9 PR:SC_CP	0.386
WTP_{10} TT:SC_CP	-1.707 (NOK/minute)

7.5 Comparison of subgroups in the sample

Among the sample, different utility functions are derived based on different subgroups. Different characteristics of subgroups towards E-grocery channel will be discussed in the following part, in terms of experiences on E-grocery, whether performing dedicated shopping trip, age, gender, salary, and purchasing bags (amount of products purchased). Analysing different subgroups could contribute to better market segmentation understandings and better target marketing strategies.

First, Table 7- 4 and Table 7-5 presents the results of subgroups for those who have previous E-grocery experience and those who not. The numbers of ASCs indicate that consumers who have E-grocery experiences prefer HD. The attributes of TW and PR have less influence on consumers preference because the coefficients of them are not significant. For the people who does not have E-grocery experiences, they prefer in store, whereas it is not significant and statistically equals to zero. Thus, there might not be different between HD and in store. By comparing WTP between two subgroups, the following results illustrate that people who have ever purchase grocery online would like to pay more product price for saving travel time than people who do not. Whereas, the latter would like to pay more CP service cost to save travel time than the former.

$$WTP_{No1} = -\frac{\beta_{TT}}{\beta_{PP}} = -\frac{-.03061}{-.01349} = \text{-2.269088213 (NOK/minute)}$$

$$WTP_{Yes1} = -\frac{\beta_{TT}}{\beta_{PP}} = -\frac{-.02385}{-.00491} = \text{-4.857433809 (NOK/minute)}$$

$$WTP_{No2} = -\frac{\beta_{TT}}{\beta_{SC\_CP}} = -\frac{-.03061}{-.01782} = \text{-1.717732884 (NOK/minute)}$$

$$WTP_{Yes2} = -\frac{\beta_{TT}}{\beta_{SC\_CP}} = -\frac{-.023851}{-.01814} = \text{-1.31477398 (NOK/minute)}$$

Table 7-4. The output for the subgroup who have not purchased grocery online before

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.01349***	.00194	-6.96	.0000	-.01729	-.00969
SC_HD	-.01731***	.00263	-6.59	.0000	-.02247	-.01216
TW	-.00502*	.00297	-1.69	.0906	-.01084	.00079
PR	.00681***	.00191	3.56	.0004	.00306	.01056
LT	-.06356***	.01717	-3.70	.0002	-.09720	-.02991
ASC_CP	-.56255**	.24021	-2.34	.0192	-1.03336	-.09175
TT	-.03061***	.00623	-4.92	.0000	-.04281	-.01840
SC_CP	-.01782***	.00387	-4.61	.0000	-.02540	-.01025
ASC_SM	.07310	.23428	.31	.7550	-.38608	.53229

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

Table 7-5. The output from the subgroup who have purchased grocery online before

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00491**	.00214	-2.30	.0215	-.00910	-.00072
SC_HD	-.02167***	.00447	-4.85	.0000	-.03042	-.01291
TW	-.00343	.00498	-.69	.4910	-.01318	.00633
PR	.00511	.00340	1.50	.1329	-.00155	.01177
LT	-.10928***	.03078	-3.55	.0004	-.16961	-.04895
ASC_CP	-1.60648***	.45617	-3.52	.0004	-2.50056	-.71239
TT	-.02385***	.00804	-2.97	.0030	-.03961	-.00810
SC_CP	-.01814**	.00764	-2.38	.0175	-.03311	-.00318
ASC_SM	-1.02240**	.45065	-2.27	.0233	-1.90565	-.13915

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

Table 7-6 and 7-7 reveal that the interviewees who usually perform dedicated trip for grocery shopping prefer HD followed by in store. For the interviewees who do not usually perform dedicate trips, although the ASC_SM is higher than zero, statistically insignificant means no difference between HD and store. Different types of WTP are calculated and the one with biggest difference between two subgroups is the valued of travel time for product price. People who perform dedicated trip would like to pay 2.86 NOK to save 1 minute travel time, whereas people who usually do not perform dedicated trip would like to pay 4.27 NOK. The incentive of grocery shopping for subgroups might be the reason to explain the difference. People who perform dedicated trip are either unable or unwilling to chain grocery shopping with other activities. The latter are willing to dedicate a certain period of time to perform grocery shopping due to various reasons, such as entertainment and social factors. Whereas those who chain grocery shopping with other activities usually aims at products themselves. Therefore, it is not surprise the value of travel time for performing dedicate trip is less than the other.

Table 7-6. The output for the subgroup who usually perform dedicated

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00881***	.00152	-5.79	.0000	-.01179	-.00582
SC_HD	-.01916***	.00257	-7.44	.0000	-.02421	-.01411
TW	-.00553*	.00288	-1.92	.0553	-.01118	.00013
PR	.00625***	.00189	3.30	.0010	.00254	.00996
LT	-.07076***	.01710	-4.14	.0000	-.10427	-.03726
ASC_CP	-1.12823***	.24200	-4.66	.0000	-1.60253	-.65392
TT	-.02520***	.00555	-4.54	.0000	-.03608	-.01432
SC_CP	-.01361***	.00395	-3.44	.0006	-.02135	-.00586
ASC_SM	-.46637**	.23459	-1.99	.0468	-.92616	-.00657

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

Table 7-7. The output for the subgroup who do not perform dedicated trip

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.01063***	.00377	-2.82	.0048	-.01801	-.00324
SC_HD	-.01579***	.00459	-3.44	.0006	-.02479	-.00680
TW	-.00106	.00502	-.21	.8336	-.01090	.00879
PR	.00847**	.00329	2.58	.0100	.00202	.01491
LT	-.07948***	.02974	-2.67	.0075	-.13777	-.02119
ASC_CP	.19587	.41590	.47	.6377	-.61927	1.01101
TT	-.04544***	.01038	-4.38	.0000	-.06578	-.02510
SC_CP	-.02838***	.00690	-4.11	.0000	-.04191	-.01485
ASC_SM	.72642*	.40838	1.78	.0753	-.07399	1.52684

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

Focusing on the age subgroups, ASC_SM for both groups over 35 years old and below 34 years old are not statistically significant. Although they are higher than zero, there is no difference in the preferences between HD and in store, according to the Table 7-8 and 7-9. TW is an insignificant explanatory variable for the people who are over 35 years old. Interestingly, the results from calculated WTP reflect that people who are older than 35 years are willing to pay more service cost to save travel time and pay less product price compared with respondents who are under 34 years old.

$$WTP_{\geq 35PP} = -\frac{\beta_{TT}}{\beta_{PP}} = -\frac{-.02531}{-.01090} = \text{-2.322018349 (NOK/minute)}$$

$$WTP_{\geq 35SC\_CP} = -\frac{\beta_{TT}}{\beta_{SC\_CP}} = -\frac{-.02531}{-.66319} = \text{-2.079704191 (NOK/minute)}$$

$$WTP_{\leq 34PP} = -\frac{\beta_{TT}}{\beta_{PP}} = -\frac{-.03194}{-.00799} = \text{-3.997496871 (NOK/minute)}$$

$$WTP_{\leq 34SC\_CP} = -\frac{\beta_{TT}}{\beta_{SC\_CP}} = -\frac{-.03194}{-.86514} = \text{-1.506603774 (NOK/minute)}$$

Table 7-8. The outputs for the subgroup who are more than 35 years old

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.01090***	.00200	-5.44	.0000	-.01482	-.00697
SC_HD	-.01205***	.00391	-3.08	.0020	-.01970	-.00439
TW	-.00175	.00433	-.40	.6863	-.01024	.00674
PR	.00769***	.00283	2.72	.0066	.00214	.01325
LT	-.09116***	.02632	-3.46	.0005	-.14275	-.03957
ASC_CP	-.66319**	.32938	-2.01	.0441	-1.30876	-.01762
TT	-.02531***	.00723	-3.50	.0005	-.03947	-.01114
SC_CP	-.01217**	.00565	-2.15	.0313	-.02325	-.00109
ASC_SM	.12653	.31336	.40	.6864	-.48763	.74070

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

Table 7-9. The outputs for the subgroup who are less than 34 years old

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00799***	.00209	-3.82	.0001	-.01209	-.00389
SC_HD	-.02132***	.00281	-7.60	.0000	-.02682	-.01582
TW	-.00632**	.00312	-2.03	.0428	-.01244	-.00020
PR	.00671***	.00203	3.31	.0009	.00273	.01068
LT	-.06452***	.01802	-3.58	.0003	-.09984	-.02920
ASC_CP	-.86514***	.27224	-3.18	.0015	-1.39871	-.33157
TT	-.03194***	.00667	-4.79	.0000	-.04500	-.01887
SC_CP	-.02120***	.00437	-4.85	.0000	-.02977	-.01262
ASC_SM	-.35306	.26819	-1.32	.1880	-.87872	.17259

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

The estimated data proves that male prefer HD, whereas female prefer in store if ignoring other designed variables and only considering ASCs. However, Table 7-10 and 7-11 reveal that female are willing to pay more service cost to save travel time than male. It can imply that male prefer saving shopping time spending in the store, but female prefer saving traveling time to the store. It is noting that female might be more enjoy shopping process psychologically. They like the atmosphere in the store and like to feel and touch the products. Whereas male prefer saving shopping time, and they usually go straight to get what they want and pay, according to the literature and interviews. Therefore, the market strategies should be designed differently for male and female. Besides, for female, TW is not considered as a statistically significant variable that can affect female consumers preference.

$$WTP_{male} = -\frac{\beta_{TT}}{\beta_{SC\_CP}} = -\frac{-.02129}{-.02177} = \text{-0.977951309 (NOK/minute)}$$

$$WTP_{female} = -\frac{\beta_{TT}}{\beta_{SC\_CP}} = -\frac{-.03610}{-.01327} = \text{-2.720422005 (NOK/minute)}$$

Table 7-10. The outputs for the subgroup of male

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00699***	.00204	-3.43	.0006	-.01099	-.00299
SC_HD	-.01908***	.00310	-6.16	.0000	-.02514	-.01301
TW	-.00787**	.00345	-2.28	.0226	-.01463	-.00111
PR	.00491**	.00228	2.16	.0311	.00045	.00937
LT	-.07898***	.02030	-3.89	.0001	-.11877	-.03920
ASC_CP	-1.09729***	.30071	-3.65	.0003	-1.68667	-.50790
TT	-.02129**	.00836	-2.55	.0109	-.03767	-.00491
SC_CP	-.02177***	.00474	-4.60	.0000	-.03106	-.01249
ASC_SM	-.90363***	.30062	-3.01	.0026	-1.49284	-.31442

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

Table 7-11. The outputs for the subgroup of female

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.01164***	.00201	-5.80	.0000	-.01557	-.00771
SC_HD	-.01796***	.00331	-5.43	.0000	-.02444	-.01147
TW	-.00087	.00369	-.23	.8146	-.00810	.00637
PR	.00855***	.00240	3.57	.0004	.00385	.01324
LT	-.07068***	.02205	-3.21	.0013	-.11389	-.02747
ASC_CP	-.50997*	.29841	-1.71	.0875	-1.09484	.07490
TT	-.03610***	.00623	-5.80	.0000	-.04830	-.02390
SC_CP	-.01327***	.00500	-2.65	.0079	-.02307	-.00347
ASC_SM	.54429*	.28454	1.91	.0558	-.01340	1.10199

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

The information of salary subgroup generated from survey is classified into three groups: lower than 21000 NOK, between 21000-48000 NOK, and over 48000 NOK. Generally, by observing Table 7-12, 7-13 and 7-14, the ASC_SM is not significant for all three salary subgroups, and HD is preferred as a grocery choice channel. Besides, there is no statistically difference in the preferences among the three alternatives for the respondents whose salary is between 21000 to 48000 NOK. The common trend can be proved from the data and presented in the Table 7-15 that with the increasing of salary, people are willing to pay more service cost for saving lead time. Due to insignificant of the attribute of TW, it can not to be used to calculate WTP. It is noting that the respondents with salary range between 21000 to 48000 NOK are willing to pay more product price to save travel time than the people who have higher salary over 48000 NOK.

Table 7-12. The outputs for the subgroup whose salary is lower than 21000 NOK

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00629**	.00272	-2.31	.0209	-.01162	-.00095
SC_HD	-.02330***	.00365	-6.39	.0000	-.03045	-.01615
TW	-.00541	.00395	-1.37	.1713	-.01315	.00234
PR	.00667**	.00265	2.52	.0119	.00147	.01187
LT	-.04930**	.02336	-2.11	.0348	-.09509	-.00351
ASC_CP	-.90326***	.34366	-2.63	.0086	-1.57681	-.22971
TT	-.01910***	.00718	-2.66	.0078	-.03317	-.00503
SC_CP	-.02790***	.00607	-4.60	.0000	-.03980	-.01600
ASC_SM	-.49907	.33689	-1.48	.1385	-1.15937	.16123

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

Table 7-13. The outputs for the subgroup whose salary is between 21000-48000 NOK

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.01840***	.00330	-5.57	.0000	-.02487	-.01192
SC_HD	-.01891***	.00435	-4.35	.0000	-.02744	-.01038
TW	-.00199	.00492	-.41	.6854	-.01163	.00764
PR	.00339	.00320	1.06	.2895	-.00289	.00968
LT	-.10033***	.02810	-3.57	.0004	-.15541	-.04524
ASC_CP	-.27892	.40525	-.69	.4913	-1.07320	.51535
TT	-.05215***	.01177	-4.43	.0000	-.07522	-.02909
SC_CP	-.01422**	.00621	-2.29	.0221	-.02640	-.00204
ASC_SM	.37903	.39653	.96	.3391	-.39814	1.15621

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

Table 7-14. The outputs for the subgroup whose salary is over 48000 NOK

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00769***	.00199	-3.86	.0001	-.01160	-.00379
SC_HD	-.01228***	.00418	-2.94	.0033	-.02046	-.00409
TW	-.00526	.00451	-1.16	.2440	-.01410	.00359
PR	.00941***	.00291	3.23	.0012	.00370	.01512
LT	-.08373***	.02785	-3.01	.0026	-.13831	-.02915
ASC_CP	-.98266***	.35808	-2.74	.0061	-1.68448	-.28084
TT	-.03214***	.00938	-3.43	.0006	-.05051	-.01376
SC_CP	-.01145*	.00592	-1.93	.0531	-.02305	.00015
ASC_SM	-.15525	.34538	-.45	.6531	-.83219	.52169

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

Table 7-15. Values of different types of WTP for three salary groups

Value of WTP	Lower 21000 NOK	Between 21000-48000 NOK	Over 48000 NOK
$WTP_{TT:PP}$	-0.684587814	-3.667369902	-2.8069869
$WTP_{LT:SC\_CP}$	-0.029450418	-0.117592593	-0.121877729
$WTP_{LT:SC\_HD}$	-0.035264664	-0.08842764	-0.113640065

Finally, the paper is interested in the subgroups divided by the amount of products they buy which is represented by the average shopping bags per purchase. The respondents who usually have 1-2 shopping bags do not have statistically significant preference between HD and in store, although the number of ASC in store is higher than zero. The respondents who have more than 3 shopping bags prefer HD according to the information from Table 7-16 and 7-17. Through comparing different types of WTP, people who have more than 2 shopping bags are willing to pay more product price and service cost for getting more product choice and saving more lead

time than people who usually have 1-2 shopping bags.

Table 7-16. The outputs for the subgroup who usually buy grocery with 1-2 bags

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.01491***	.00255	-5.84	.0000	-.01991	-.00991
SC_HD	-.02077***	.00271	-7.67	.0000	-.02607	-.01546
TW	-.00456	.00299	-1.53	.1263	-.01041	.00129
PR	.00599***	.00195	3.08	.0021	.00217	.00981
LT	-.05437***	.01762	-3.09	.0020	-.08890	-.01984
ASC_CP	-.59873**	.24831	-2.41	.0159	-1.08542	-.11204
TT	-.04247***	.00632	-6.73	.0000	-.05485	-.03010
SC_CP	-.02005***	.00408	-4.91	.0000	-.02805	-.01205
ASC_SM	.09556	.24193	.40	.6928	-.37860	.56973

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

Table 7-17. The outputs for the subgroup who usually buy grocery more than 3 bags

ANS_1	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
PP	-.00701***	.00179	-3.91	.0001	-.01053	-.00350
SC_HD	-.01143***	.00425	-2.69	.0072	-.01977	-.00310
TW	-.00407	.00480	-.85	.3962	-.01348	.00533
PR	.00744**	.00318	2.34	.0193	.00121	.01367
LT	-.11611***	.02849	-4.07	.0000	-.17196	-.06027
ASC_CP	-1.18091***	.39790	-2.97	.0030	-1.96078	-.40105
TT	-.00342	.00907	-.38	.7063	-.02120	.01436
SC_CP	-.01337**	.00652	-2.05	.0403	-.02614	-.00059
ASC_SM	-.71554*	.39512	-1.81	.0702	-1.48997	.05889

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

8. Policy implications

This part will first analyse E-grocery's market share under current market condition. The values of parameters are real data taken from the most popular E-grocery retailers in Norway. Estimations and assumptions on customer related parameter, such as travel time, are based on the information collected from the interviews. Second, it is important to find out how the market will react to specific managerial policies. Therefore, scenario simulations are conducted in order to test market effects regarding changes in E-grocery retailing policies. Based on the result, suggestions on managerial policy implications are discussed in 8.3. Finally, since the growth of E-grocery will have impacts on freight distribution, implications regarding freight logistics are given in the last part.

8.1 Analysis of current market share

In order to understand current grocery market share, the analysis is based on realistic conditions in the market. As discussed in section 4, E-grocery market in Norway is shared by pure online retailers and multi-channel retailers from NorgesGruppen.

The multi-channel retailers are operating on the similar strategies. For MENY, SPAR and Joker, service cost for HD is 59 NOK (some areas 69 NOK) if the basket size is larger than 1000 NOK. For orders under 1000 NOK, the service cost is 89 NOK. Service cost for CP is 0 NOK if the basket size is larger than 1000 NOK, and 49 NOK for orders under 1000 NOK. The order preparation time varies from 6 hours to 23 hours and delivery time window is typically 2 hours. SPAR claims that their product range online is the same as their product range in store. This assertion is reasonable since their E-grocery service is store based, which means the online orders are picked up from stores. Although one cannot neglect the fact that each store has difference in product range, for the sake of calculation, such differences are not considered.

Based on the explanatory conditions mentioned above, the market share of three alternatives can be calculated with the MNL model presented in equation (2.3). For large basket size in which product cost is over 1000, assuming that lead time is 12 hours and the purchase costs are the same among three alternatives. The pre-interviews show that the average travel time is around 20 minutes for a consumer. Using the parameters above, one can derive the deterministic part of utility functions for the three alternatives:

$$V_{store} = -0.15848 - 0.00920 \times 1000 - 0.02967 \times 20 + 0.00670 \times 100\% = -9.28188$$

$$V_{hd} = -0.00920 \times 1000 - 0.01809 \times 59 - 0.00437 \times 120 + 0.00670 \times 100\% - 0.07266 \times 12 = -10.99363$$

$$V_{cp} = -0.77234 - 0.00920 \times 1000 - 0.02967 \times 20 - 0.01738 \times 0 + 0.00670 \times 100\% - 0.07266 \times 12 = -10.7677$$

Accordingly, the exponential value of each alternatives is:

$$exp(V_{store}) = 9.31E - 05$$

$$exp(V_{store}) = 1.68084E - 05$$

$$\exp(V_{store}) = 2.11E - 05$$

Using MNL model, the probability for each consumer choosing one of the three alternatives are:

$$P(Store)=71.08\%$$

$$P(hd)=12.83\%$$

$$P(cp)=16.09\%$$

For small basket size in which product cost is under 1000, under the same assumption of lead time, the market share of the three alternatives are:

$$P(Store)=83.23\%$$

$$P(hd)=8.73\%$$

$$P(cp)=8.04\%$$

The estimated market share demonstrates that for multi-channel retailers, in store grocery shopping have the largest market share regardless of basket size. However, consumers have higher possibilities to choose E-grocery service if the basket size is larger than 1000 NOK. This is due to lower service cost linked to large basket size for both HD and CP alternatives.

As the largest pure online grocery retailer, Kolonial is a warehouse-based grocer that sells around 6000 grocery products online. As discussed in 4.3.1, overall, Kolonial's price can be 2,7% higher than Kiwi with home delivery, and 0,4% cheaper than Kiwi if consumer choose click and pick. The delivery time window is normally 2-5 hours. However, Kolonial offers express services that can delivery grocery within 90 minutes after the orders being placed. Normally, HD service cost is between 0-59 NOK. With express service, home delivery costs 299 NOK. CP is provided by Kolonial at a cost of 39 NOK if purchase cost is less than 400 NOK. There is no service cost for basket size over 400 NOK. Moreover, if customers choose click and pick, they can get 3% discount on purchase regardless of the basket size. Kolonial has around 40 pickup point locating in Oslo and the adjacent areas.

For Kolonial's common service, one schedules delivery for the other day. In this scenario, one can assume that for home delivery, purchase cost is identical to store, an average service cost is 39 NOK. The most common time window is 2 hours, and lead time 12 hours. While for click and pick, purchase cost has 3% discount and service cost is free. It can be assumed that the

travel time to pick up point is half as the travel time to store. Under above mentioned condition, the market share for basket size of 1000 NOK is presented as follow:

$$P(\text{store})=61.81\%$$

$$P(\text{hd})=14.99\%$$

$$P(\text{cp})=23.20\%$$

Kolonial's special offer, express delivery, is also interesting to be analysed. With purchase cost remain unchanged, service cost is changed to 299 NOK. Lead time is reduced to 1 hour and time window 30 minutes for express delivery. Conditions for click and pick remains the same.

$$P(\text{store})=72.33\%$$

$$P(\text{hd})=0.52\%$$

$$P(\text{cp})=27.14\%$$

From the model estimation, it is shown that under the current market condition, in store shopping has larger market share than E-grocery. The estimation also demonstrates that consumers are generally more in favour of click and pick with respect to home delivery. This is due to Kolonial's unique pricing strategy that encourages customer to pick up their own groceries. Moreover, the estimation illustrates that express delivery is still a niche market and have small market share with respect to scheduled delivery. The parameter specification of all the market condition mentioned above are listed in Appendix V.

8.2 Scenario simulation

After developing a satisfactory model estimation, policy analysis can be carried out based on scenario simulations. Certain policy regarding one or multiple attributes can be tested in order to summarise the behavioural information. The aggregated market reactions resulting from the policies are analysed accordingly. In this part, a set of market scenarios will be defined and compared with the base model. Each scenario can have multiple changes with respect to the base model. The multi-channel grocery retailers market share is used as base model.

Scenario 1: From partitioned prices to free service cost

E-grocery retailers mainly pursue two types of pricing strategies: free shipping and partitioned prices. For store-based multichannel retailers, both strategies can lead to higher gross prices with respect to in store shop5ping. However, for warehouse or dark store based pure online retailers, it is possible that gross price is lower than stores, due to their low operation cost and market entry cost.

It is of great interests to find out whether consumers in Norway prefer free service cost or partitioned prices. A price simulation can be conducted in order to investigate the question. Assume a scenario where product price is identical for all three alternatives. The service cost can be included in the gross price or set as partitioned fee. Suppose the service fee is 89 NOK for HD and 49 NOK for CP. The simulation result shows the effect of adoption of free shipping (no service cost) increase the probability of choosing E-grocery (including HD and CP) to 27.3%.

Scenario 2: Lead time is reduced from 12 hours to 6 hours.

It is quite likely that in the future, the time used for order picking and order preparation can be reduced. Therefore, the effect of this scenario needs to be investigated. Reduction of order preparation time can be achieved with better information system, automated pick-up system, as well as eliminating idle time within supply chain. Assume all the other parameters remain the same (i.e SC_HD is 89 NOK, and SC_CP is 49 NOK. PR is 100% for all alternatives and TW is 120 min. TT are identical for in store and CP) Reducing lead time from 12 hours to 6 hours increases total market share of E-grocery to 23.8%.

Scenario 3: Reducing the time window from 2 hours to 1 hour.

Some E-grocery are trying to implement innovative last mile delivery methods, such as drone and autonomous vehicle, to reduce the delivery time window. Additionally, time window can be reduced by means of transportation routine optimization and order tracking information sharing. It is important to find out whether such efforts can greatly improve market share of home delivery. In this scenario, only the value of time window is manipulated (i.e. SC_HD is 89 NOK, and SC_CP is 49 NOK. PR is 100% for all alternatives and LT is 12 hours. TT is identical for in store and CP). Reduction of time window will increase market share of home delivery from 8.7% to 11.1%.

Scenario 4: Increasing product range by 20%

Currently, Norwegian E-grocery retailers generally have less product range than stores. However, in the future, it is possible that a warehouse-based E-grocers will have higher product range than the stores. Some E-grocery retailers are planning to invest on larger distribution centre in order to offer wider range of products. It is interesting to see how much profit the investment can possibly bring. In this scenario, product range of E-grocery is raised to 120% with respect to stores. The effect of the raise is that the total market share of E-grocery will increase from 16.8% to 18.7%.

Scenario 5: Reducing travel time by 50%

Reduction of travel time is applied to CP alternative since HD does not concern it. A drive-out pick up point allows customers to pick up their groceries without traveling to store. It is reasonable to assume that a customer chooses a pick-up point with shorter travel time than to stores. It could be beneficial to expand the drive-out pickup point network as it could encourage customers to choose CP. In this simulation, assuming E-grocers plan to increase the number of pickup points so more consumers could benefit from shorter travel time. Accordingly, travel time to the pickup point is set to 10 minutes while travel time to stores is set to 20 minutes. The result shows that market share for click and pick is gained from 8.0% to 10.5%.

The results of policies' implementation are summarised in Table 8-1. To sum up, using the choice model defined, it is found that under current market condition, in store grocery shopping still has dominant market share. However, the market share of E-grocery could be increased by implementing appropriate policies, as the policies could enhance the E-grocery service efficiency.

Table 8-1. Effects of management policies

	IN STORE			HOME DELIVERY					CLICK AND PICK					P(i)		
	PP (NOK)	TT (MIN)	PR (%)	PP (NOK)	SC_HD (NOK)	TW (MIN)	PR (%)	LT (HOUR)	PP (NOK)	SC_CP (NOK)	TT (MIN)	PR (%)	LT (HOUR)	STORE	HD	CP
Base	500	20	100	500	89	120	100	12	500	49	20	100	12	83,2 %	8,7 %	8,0 %
Scenario 1	500	20	100	589	0	120	100	12	549	0	20	100	12	72,7 %	16,8 %	10,5 %
Scenario 2	500	20	100	500	89	120	100	6	500	49	20	100	6	76,2 %	12,4 %	11,4 %
Scenario 3	500	20	100	500	89	60	100	12	500	49	20	100	12	81,1 %	11,1 %	7,8 %
Scenario 4	500	20	100	500	89	120	120	12	500	49	20	120	12	81,3 %	9,8 %	9,0 %
Scenario 5	500	20	100	500	89	120	100	12	500	49	10	100	12	81,0 %	8,5 %	10,5 %

8.3 Managerial implications

8.3.1 Pricing strategy

Pricing strategies of E-grocery retailing influence sales and thus market share. Therefore, it is important to identify the market reaction towards different pricing strategies. For e-commerce, a critical strategy to identify is whether shipping cost be charged as partitioned prices or be included in the product cost (Frischmann, et al., 2014). Price partitioning means separating total price into product price and surcharge (service cost). Partitioned price can have advantages as customers believe they have more insight of retailers cost structure. This can motivate customers to make purchase, even though their perception is not always true. In addition, retailers can gain profit from partitioned service fee by setting the service fee higher than their cost (Frischmann, et al., 2014). In the current Norwegian E-grocery market, both free shipping and partitioned shipping price strategies are adopted. NorgesGruppen's multi-channel retailers are using partitioned service for E-grocery. For larger baskets home delivery, the additional service costs are cheaper, while the service fee for large basket CP is free. Kolonial uses price discrimination to stimulate consumers to choose from different basket size, delivery lead time and time window.

However, according to the model estimation and simulation, free service cost is preferred by the customers and will increase E-grocery market share. The experiment results show consumers are more sensitive to service cost than purchase cost. From customers' perspective, E-grocery are linked to uncertainty, especially for the new E-grocery users. Certain consumers are sceptical towards extra shipping costs (Frischmann, et al., 2014). Therefore, people's purchasing attitude are more positive when they are exposed to "free shipping offer". From retailer's perspective, free service charge helps to refrain consumers from quitting the shopping process (Frischmann, et al., 2014). When customers start trying to purchase E-grocery, the extra service cost will make them hesitate and possibly drop out from purchasing process.

Given the findings from experiment, a promising pricing strategy is to offer free service cost and at the same time increase the net product price. As a result, the product price will be higher. The increased product price compensates the absent service cost. This strategy could potentially attract more customers and increase market share of E-grocery. Currently, the food box provider such as Adams matkasse and Godtlevert are offering free shipping. Since they offer standardized grocery baskets, the transportation costs are easier to be included in the price.

However, from a long-term perspective, free service cost policy has drawbacks also. First, service cost can be used as a mark to motivate consumers to buy larger amount of groceries. For instance, if the purchase price exceeds 1000NOK, service fee for home delivery is 50%. Second, price discrimination on service cost can be adopted for different delivery time window. In another word, if the customer wants the order to be delivered on Friday after work, the service cost will be higher than delivering on Tuesday morning. This encourages the consumer to choose a delivery time slot where there is less traffic. Thus, the transport routine planning is easier for the retailers.

One could not neglect the fact that consumers channel choice is an evolving process. When consumers are firstly introduced to a new channel, they can be more responsive to marketing effort (Valentini et al. 2011). Therefore, a dynamic pricing strategy can be considered. This is to say, offering free shipping for consumer who are new to the E-grocery channel. When they get more familiarized with E-grocery or even forming a habit with strong loyalty, a different pricing strategy can be applied.

8.3.2 Marketing strategy towards different social demographic groups

As presented in the model estimation, E-grocery in Norway is not limited to a single demographic of Norwegian consumers. Instead, various demographics of consumers have different household needs E-grocery service. To capitalise on the growth of E-grocery market, the grocery retailers should have personalized marketing strategy based on the crafted marketing messages.

Econometric results show that males prefer home delivery service while females prefer in store shopping, if no market conditions are specified. In addition, from the pre- and post-interviews, it is found both males and females are responsible for buying groceries for the households. Therefore, marketing effort of E-grocery should be applied to male customers in order to keep their interests. Whereas females should be targeted as potential users to the new channel. Moreover, the interviews reveal that when going to stores, males do not mind the travel time but they do not like the queue and crowd in store. While females do not like long travel time, yet they enjoy the shopping process and the atmosphere in store. This might be the explanation that why regression models show females are willing to pay more in order to save travel time comparing to males. Given this finding, the marketing strategy towards man and woman can be different. When approaching male customers, E-grocery could be presented as a solution to

avoid the queue and chaos in store. On the other hand, when approaching females, E-grocery should be described as a service that can free them from the long shopping trip with heavy groceries at hand.

People who have previous E-grocery shopping experiences prefers HD, while people without such experiences still prefers in store shopping. In fact, during the interviews, it is found that one third of the respondents do not aware of the fact that they can purchase grocery online. Around half of the respondents have considered buying E-grocery yet only 25% of them actually conducted purchase. When introducing to new channel, most people can be sceptical, especially towards the freshness and quality of grocery. Therefore, as mentioned previously, a different pricing strategy can be adopted for the new customers in order to attract them to E-channel. Free shipping as well as special discount for new customers can be adopted. Moreover, different marketing campaigns emphasizing grocery quality and transaction safety can be conducted in order to diminish the sceptics from new customers. Additionally, retailers can offer standard brands which are identifiable to consumers. A "no question" refund policy can also be adopted to obtain consumers' trust.

Family income range might influence attitudes towards E-grocery. The analysed econometric results reveal that people with higher income are willing to pay more for a faster delivery service. Therefore, retailers can offer different delivery services according to customer needs. For instance, the express delivery with Kolonial. The grocery can be delivered 90 minutes after the order is placed with the extra service cost of 299 NOK. E-grocery retailer could segment the market and provide personalized offers. Example can be that families with high income get offers on gourmet food or family package, whereas individuals living alone receive more promotion on standard and convenient food.

8.3.3 A warehouse-based solution

In Norway, the multi-channel grocers are store based while pure online retailer are warehouse based. Each model has their advantages and drawbacks. The store-based retailers benefit from the established brand name and familiarity and do not need to have extra marketing investment on the brand recognition. Moreover, the store-based retailers already have a distribution network all over the country. It is easier for multi-channel retailers to start online business without large market entering cost, such as building a warehouse in the region.

However, the store-based operations are not suitable for long term profitability. First, it can be

difficult to keep stock availability due to uncertainty in demand forecast. Store based retailer have to meet the demand for both in store customer and online customers. Therefore, they need to carry extra stock which will lead to higher inventory cost. Requirement on higher inventory also eliminated smaller stores from the consideration of offering E-grocery. Second, the layout of the products in a grocery store is designed from a customer's perspective. Usually a customer need to walk through the whole store before reaching the checkout point. This layout is designed to motivate customers to purchase more items, and it is not efficient for E-channel order picking. Third, multi-channel retailers are restrained by the store opening hour. Online order pick and pack need to be conducted during store business hours, and most of the stock refilling needs to be carried out before or after opening hours.

In comparison, warehouse-based E-grocery operation requires high market entry cost. The retailer needs to build warehouse and the warehouse covers only limited areas. Unlike other types of goods, grocery requires particular warehouse infrastructure and regulation. It is unlikely that a warehouse-based retailer offers E-grocery service to the whole Norway. Also, warehouse-based retailers can suffer from disadvantages as lack of recognition and familiarity comparing to stores. Moreover, goods return can be a problem for warehouse-based retailer even though returning of groceries happens rarely.

Despite the disadvantages, some argue that warehouse-based retailing can have greater flexibility and efficiency relative to store-based E-grocery (Murphy, 2003). First, a warehouse-based retailer has possibility to exceed stores in terms of product range. Large centralized distribution centre can offer customers wider range of assortments. Second, a warehouse-based operation can be design to optimize the E-grocery retailing, instead of customer-oriented operation in stores. For example, the products can be placed for replenishment and online order picking efficiency, not for catching customers' eyes. Third, without the demand from in store customers, a warehouse-based retailer can have better demand forecast. This can lead to higher stock availability. Moreover, the warehouse-based operation enables small retailers to enter the E-grocery market by sharing distribution centre. In short, warehouse-based operation is argued to be more suitable for E-grocery retailing. It has potential to have higher product range, and the operations can be designed to optimize online channel so as to reduce the lead time and operational cost.

In Norway, Kolonial has the largest market share in E-grocery market. Kolonial has a regional distribution centre that covers 13000m^2. The distribution centre serves mainly Oslo area.

Kolonial claims to have lower product price and larger product range with respect to normal grocery stores. However, Kolonial does not have capacity to expand the business scope to whole Norway by far. NorgesGruppen's multi-channel stores have large scale of service areas yet the store-based operation may not be optimized for E-grocery and the business model may not be efficient for long term profit.

It is a trend that stores are getting fewer and larger, so are the supply centres. For E-grocery, the winner of the market should be a retailer that has a national transport system, as well as large regional distribution centres. As the biggest retailer in Norwegian grocery market, NorgesGruppen could integrate its resources and start a pure online retailer on national level with the use of ASKO distribution system. ASKO already have long experience in shipping products from countries of origin to major clients in Norway. Therefore, it is possible for ASKO to make an end-to-end supply chain for E-grocery. In the future, owning an efficient national logistic network will be the essential requirement to develop E-grocery market. In addition, as the main supplier of all NorgesGruppens store, ASKO have large assortment that can possibly exceed stores. The feasibility of this suggestion can be studied in further research as this could be an efficient E-grocery operation solution.

8.4 Implications on urban freight transportation

The full set ASCs represent the observed market share. From the estimated model, one can see that if no parameter is predefined, HD is mostly preferred with respect to the other two alternatives. The increasing trend of HD will affect the urban freight logistics as grocery shopping is the most frequent shopping activity. The basic assumption is, if one is used to carry out dedicated grocery shopping trips, then these trips can be substituted by home delivery.

From the urban freight logistic view, HD is most problematic comparing the other two alternatives. Yet this is the most preferred option. The challenge in home delivery lies in cost control, logistic planning, as well as last mile delivery. Delivery to customers increases fragmentation of shipments in the "last-mile" (Morganti, et al., 2014). In this part, several implications relating to freight transport will be discussed.

8.4.1 Information technologies and innovative transport vehicles

Transportation efficiency can be enhanced by improving the use of information and infrastructure. Information improves time efficiency and reduces the cost in delivery

transportation. Information technologies helps increasing delivery accuracy and customer satisfaction. For grocery home delivery, customer might experience the problems as delivery delay, long delivery time, delivery failure, and they are forced to stay at home for most of the cases. Unlike other types of goods, groceries are mostly perishable. Therefore, a second time delivery are often linked to high cost for retailers. Information sharing between customers and logistic providers can thus increase the logistic performance. On one hand, having real time information from customer side helps logistic provider to improve the transport planning. On the other hand, real time tracking of grocery orders makes customers' waiting time flexible. For example, customers can track the location of their grocery order. If the delivery is delayed, the customers can get an update of new ETA and make use of their time accordingly. In this way, the time window is continuously updated. By principle, information sharing can reduce customers waiting time and thus reduce the time window.

In urban areas, logistic performance is often hindered by traffic congestion, accidents, transportation delays and pollutions. Intelligent Transportations System (ITSs) can be used in E-grocery delivery system in order to improve road capacity utilization, save labour cost, enhance road safety and reduce pollution (Cagliano, et al., 2014). ITSs is a data driven system that enables E-grocery retailers and transport providers to have overview of whole supply chain. Activities as order placement, inventory control, freight and vehicle tracking can be monitored with ITSs applications. The adoption of ITS makes information flow in E-grocery logistic system more reliable and efficient.

Another solution for better delivery performance is innovative vehicles. Autonomous vehicles and new engine technologies contribute to novel means in home delivery. Kolonial has already tested delivering groceries with drone. However, it is still in a trial phase and only small amount of products are delivered by drones. The autonomous vehicles with environmental friendly engine technologies can significantly reduce delivery cost and CO_2 emission from the long-term perspective. Nevertheless, autonomous vehicles are still not mature for markets. Electric, hybrid and Fuel Cell Electric Vehicles (FCEVs) have positive impacts on noise and emission reduction yet battery autonomy is the main constraint. Therefore, decision makers in E-grocery retailing need to consider both advantages and constrains for the new technologies and apply them accordingly.

8.4.2 Proximity stations and pickup points

Delivering grocery to a pick-up point is more cost-efficient comparing to home delivery. It has less pressure on time window and can avoid direct contact between fright carrier and customers. Pickup point is also considered as a more consolidated delivery method as it optimizes delivery routine and vehicle utilization. Moreover, since it is possible to fill the station or pickup points at night when traffic is low, this solution is more economically and environmentally beneficial.

Two types of pickup points can be distinguished: parcel service point and pack locker stations (Visser, et al., 2014). A parcel service point is a staffed pick up point. They can be in convenience stores, gas stations, supermarkets, such as MENY's drive out pickup point. Pack locker stations are unmanned pickup point using lockers, such as Kolonial's self-service pickup point. Comparing to drive-in click and pick, consumer can benefit from less travel time by using drive-out pickup point.

Due to the demand for groceries' freshness, a grocery pickup point needs to have special storage conditions and regulations, such as cool-chain technology. This could be one of the reasons that Norwegian E-grocery retailers are cautious about pickup points. Pickup points are limited in the few major cities in Norway.

Several implications can encourage consumers to choose pickup point instead of home delivery. For the first, retailers can expand the pickup points network by cooperation with small shopkeepers or investing on self-service pickup points. Pickup points can be also considered in middle sized cities in areas with high population density. Secondly, the pickup alternative can be promoted by relieving the requirement on basket size. Pickup alternative can have less requirement on basket size with respect to home delivery. Moreover, discount on product price can also be considered in order to motivate people using pickup point.

8.4.3 Cooperation on last mile delivery

Home delivery brings convenience to people but it can also be a disturbing activity due to traffic congestion and causes environmental nuisance in the residential area. For retailers and freight carriers, efficiency and cost are the main concerns linked to home delivery. In order to improve the efficiency, the decision maker in E-grocery retailer can consider a collaborative strategy to reduce the overall cost in supply chain. In Norway, the collaborative delivery can be found in other types of business such as newspaper. This model can bring ideas to E-grocery retailing.

With E-grocery, the last mile delivery activity is extended from distribution centre or stores to customers. Last mile delivery is a common logistic problem with significant constraints of time, fulfilment, and cost. Currently, most of the Norwegian E-retailers have their own delivery vehicles. A few retailers use PostNord or Bring occasionally. However, sharing capabilities with each other could develop adaptive supply chains for companies (Siikavirta, et al., 2008). Different E-grocery retailers can utilize resources and capacities by cooperating on the last mile delivery. Cooperation of last-mile delivery can establish better transportation fill rates and utilization, and reduce total travel distance. The distribution system could be more efficient and GHGs emission could be reduced. Moreover, since the routine planning can be optimized by the use of collaborative delivery, total number of routes can be reduced and customers can benefit from less waiting time window (Muñoz-Villamizar, et al., 2015).

The main concern regarding last mile delivery collaboration is linked to coordination problems. Competitors have to share a certain amount of information each other. Additionally, retailers may lose part of their vertical integration power if the delivery is made by a third-party carrier. Furthermore, when customer receive groceries, it is the third-party carrier they have direct contact with. This can result in less brand recognitions for retailers. Therefore, even though collaboration could bring multiple advantages for last mile delivery, decision makers in E-grocery retailing should be cautious when developing the strategy on collaboration.

8.4.4 Public policies

European commission's white paper on transport stated that EU needs to reduce GHGs emissions by 80-95% below 1990 levels by 2050. As transport sector is an important source of GHGs emission, a reduction of 60% GHGs by 2050 in transportation sector is required. The goal for urban freight is to have an almost CO_2 free urban distribution by 2030. In Norway, the Norwegian Capital has ambition to cut GHGs emission by 50% by 2020 compared to 1990 levels.

E-grocery has impact on both mode and volume of grocery freight transportation. The last mile delivery will be carried out by retailers instead of shoppers. E-grocery can also generate larger purchase volume. Therefore, public policies regarding urban freight transportation is required in order to achieve the emission reduction goal. Government can modify vehicles and set speed limits in order to increase the energy efficiency in transportation. Authorities can subsidize fuel-efficient engines, as well as smart and light weight vehicles. Courses can be implemented to

educate the freight vehicle driver about economical driving.

As a response to the CO_2 reduction challenges, alternative energy carriers such as biofuels, electricity and hydrogen can be encouraged to use. The Oslo city authority is now cooperating with logistic provider Bring to introduce electronic freight vehicles in its transportation operations. Oslo city has already built fast charging stations for this trial policy. ITS solutions for charging, loading and unloading are also implemented to increase the efficiency. This policy can also be used for grocery distribution, for companies as ASKO or Kolonial. Moreover, authorities can enforce the use of filters to clean gases emitted from vehicles. This can prevent the gas from entering the environment.

9. Conclusions

E-grocery has gained popularity world widely and has changed households' daily grocery shopping behaviours. In Norway, E-grocery has experienced rapid growth during the past years, yet little to no prior research has been done in the field of Norwegian E-grocery demand study. Therefore, it is important to find out what drives Norwegian households' demand in grocery purchasing channel. This thesis aims to investigate Norwegian consumers' potential demand for E-grocery shopping, as well as the implications on grocery retailing and transportation.

Through the stated preference choice modelling, the study finds that home delivery is the most preferable grocery purchasing mode, if no other market condition is specified. 82% of respondents reveal positive attitudes towards E-grocery in the future if E-grocery meets their needs perfectly. The study gives a quantified verification of the potential demand for E-grocery in Norway. This information is relevant to both grocery retailers and public policy makers. In addition, the research answered the following questions:

1. *What are the factors affecting consumer preferences towards online and offline grocery shopping channels? How these factors influence consumers choices?*

2. *How the E-grocery market share will change in Norway?*

3. *What are the implications regarding the potential demand of E-grocery?*

Consumers channel choice in grocery shopping can be influenced by various factors. Through the designing of stated preference choice experiment, the research found that among the factors, product price, service cost, lead time, time window, travel time and product range are the

attributes that affect most households' channel choices. All the attributes except product range have negative impacts on consumers utility level. The calculation of WTP shows that consumers are willing to pay 0.132 NOK product price in exchange of 1 minute less lead time, 3.225 NOK for 1 minute less travel time, and 0.475 for 1 minute less time window. Consumers are willing to pay 0.728 NOK for 1% more product assortment. Interestingly, the experiment simulation shows that consumers are more sensitive towards service cost than product cost.

With the current market condition, in store shopping still has the dominant market share. However, if no other market condition is specified, HD is the most preferred grocery purchasing mode. Given the preference structure of the sampled households, the study estimates that the introduction of some managerial policies could increase the market share of E-grocery. For instance, providing the E-grocery service at zero extra cost would raise the share from 16.8% to 27.3%.

In general, it is feasible for most retailers to implement some policies mentioned in the paper. Given the findings from the survey results, multiple implications are discussed in this paper. For the first, a dynamic pricing strategy can be considered. Offering free service cost for consumers who are new to the E-grocery channel can attract potential consumers to E-channel. Second, preliminary investigation on the types of social demographics shows that various demographics of consumers have different household needs for E-grocery services. For males and females, customers with or without previous E-grocery experiences, and household with different income ranges, customized marketing strategies should be adopted based on the cracked marketing messages. Third, the paper argues the pros and cons of store-based operation and warehouse-based operation. A warehouse-based strategy is more suitable for long-term profit in E-grocery retailing. For the current multi-channel retailers in NorgesGruppen, one suggestion can be the horizontal integration of resources. In another word, NorgesGruppen can utilize its resources and start a pure online retailer on national level with the usage of ASKO distribution system.

The growing popularity of E-grocery will have impacts on freight distribution. Implications on urban freight transportation include the use of information technologies and innovative transport vehicles, as well as different types of pickup points. Horizontal integration on the last mile delivery are suggested in order to improve the utilization of the resources. Finally, authorities can apply public policies to control CO_2 emission from freight transportation.

9.1 Contribution of this study

This study has established the following contributions to the academic environment and the grocery retailing industry:

The main contribution of this paper is that it provides a quantified evidence to verify the growing demand for E-grocery in Norway. Generally, consumers have positive attitude towards E-grocery, especially home delivery. The market share of E-grocery will grow if the service quality is improved. Currently, E-grocery is still in a niche market and account for little market share in Norway. Therefore, the usefulness of knowing this evidence is not only limited to retailers. Understanding the potential demand is also relevant to public policy makers.

In addition, this study provides a detailed database containing 202 households' choices towards grocery shopping. The data set includes Norwegian consumers' current grocery buying behaviour, stated preference choices, attitudinal values, as well as their socio demographic information. The SP database can be used for further marketing research.

Furthermore, besides a general discussion, this study looks into two E-grocery modes specifically. Instead of regarding E-grocery as a whole, home delivery and click and pick are treated as two different alternatives. Labelled stated preference choice experiments are used to estimate utility functions for all three grocery shopping alternatives, and the market shares for each alternative are estimated respectively. The estimation is valuable for decision makers in grocery retailing.

Last but not the least, policy implications are presented in this study based on the given experimental results, which could give innovative ideas to decision makers in the industry. In fact, they allow E-grocery retailers to enact appropriate management strategies within a complex and interdependent environment.

9.2 Limitations and suggestions for further research

Inevitably, there are several limitations in this study. First, when modelling the consumer channel choice, this study only takes channel attributes or economic quantified attributes into consideration. In fact, consumers choice could be influenced by other types of factors, such as social factors, psychological factors and situational factors. Second, this research ignores the fact that consumer's decision making could evolve over time. However, when a consumer is

newly introduced to the E-channel, the decision process might not be the same as when a consumer is familiar with the channel. Third, stated preference method has its drawbacks. There is no standard method to define the attributes levels. The levels are defined based on the literature reviews and common understanding in the market, which can have bias. The choice data come from people's statement, which also contains personal bias. Moreover, due to the time and cost constrains, the attributes are selected in limited numbers and the sample data are collected in limited quantities. This could also result in biasness in data set.

Since the literature on E-grocery market in Norway is still in its infancy, and the trend for E-grocery grows, more researches are called upon this subject. Further studies could focus on the development of a framework on integrations in last-mile delivery. As many literatures has suggested collaboration in last mile delivery, it would be of interest to research how the cooperation can be applied for grocery delivery specifically.

Additionally, similar studies can be carried out in different countries, and a comparative study could be conducted accordingly. As the authors believe, that consumers preferences are different in other countries. It could be meaningful to investigate the difference, and search for opportunities through differences.

Furthermore, this study did not consider interaction effects of each attributes. Yet it is reasonable to believe such effects exist in the utility functions. Therefore, based on this study, further research could build a more sophisticated model, and investigate how attributes' interaction effects influence consumers preferences towards grocery shopping channel choice.

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Appendix

Appendix I: In-depth and focus group interview guidelines

Have you shopped groceries online?

How many times do you do in-store grocery shopping per week vs. how many times do you do online grocery shopping per week?

What are the factors that made you to shift from traditional grocery shopping to online grocery shopping?

Other than grocery, do you usually purchase other retailing goods online?

What is the percentage of grocery expense account for your monthly income?

Prices

Will you compare prices between different websites or stores before you make a purchase?

Do you buy groceries according to recipes?

When you browse groceries online, will you firstly check discount offers?

How much are you willing to pay more for buying grocery online to avoid long shopping distance?

How much are you willing to pay more for buying grocery online to avoid carry heavy groceries?

How much are you willing to pay more for buying grocery online to reduce shopping time?

Grocery shopping distance and time

How long it takes for you to reach the store usually?

What transportation do you use to reach the store?

Do you perform dedicated trips to the supermarket?

At which days of the week do you prefer to do grocery shopping? (compare in-store and online)

At which time of the day do you prefer to do grocery shopping? (compare in-store and online)

How much time do you averagely use to perform in-store grocery shopping vs. online grocery shopping?

After ordering online, how long do you have to wait until you get the grocery? Do you find the waiting time acceptable?

Do you make weekly grocery shopping plan? Or do you do grocery shopping spontaneously?

Electronic service quality

How do you get the information of the product you want? Search or browse?

How do you search for the items? (Favorites, shopping list, previous orders, promotion from advertising)

Which website do you usually use for online grocery shopping? Do you think their website is well designed and easy to use?

How does the website functionality affect your decision of purchasing?

Products

Can you find all the groceries you need online?

What types of grocery do you mostly purchase online?

Do you consider certain brands when you purchase grocery online?

Is it possible to buy other alternatives when the specific product is sold out?

When you shopping, you usually buy goods based on prepared shopping list or just buy what you want in store or online?

Will you always buy more products than you already decided, if yes what kind of products are?

General reflections

Do you think buying grocery online is a good idea for people and why?

What do you think of E-grocery service in Norway?

If you chose buying grocery online, would you prefer home delivery, click and pick at the store or click and pick at the station point?

Why you chose this?

In the future, how many time do you do in-store grocery shopping per week vs. how many times do you do online grocery shopping per week?

Guidelines for company interview

1. What is your company's aim to develop online grocery shopping channel? What are the implications at a strategic tactical and operational level?

2. What are the characteristics of consumers choosing online grocery shopping and why do consumers choose online grocery? What do you believe are the main driver of this process? Do you consider this option relevant for the future/present of your company?

3. What are the company's business strategies toward consumers' demands?

- Pricing strategy
    - How do you decide the price level and why?
    - Is the pricing differentiated between on-line and click and pick? (yes/no) If yes, Why? What are the main motivations for the different price strategies for click and pick choice ?
    - Do you have any sales promotion for attracting consumers? Which are the options you are considering to develop your online market? Is there a specific "philosophy" you are following?
    - Why there is no difference between the same product in store and online? (Multi-channel)

- Logistic solution
- Could you please describe the main characteristics of the logistic solutions you have developed?
    - How do you decide which products to offer online with respect to in store?
    - How do you decide the transport routs, especially for remote areas? What are the parameters you consider to define which are the areas you serve for the e-groceries market?
    - How do you deliver the products? Under which conditions?
    - Do you use third logistic party for transportation? How do you decide whether to self-produce the delivery services or buy them from third-party logistic providers?
- Warehouse management

    - Do you share the same warehouse and stock system for online and offline shopping? (Multi-channel)
    - How do you prepare the products for the online shopping channel? Any particular staff and priority? (Multi-channel)
    - How do you forecast online channel demand? Do you find it is challenging?

- Quality
    - How do you make sure the goods quality for online consumes?
    - Is there any guarantee of the goods quality for consumers? (e.g. selling the product in fresh – at least 2 days before best before date)
    - How do you select products and product range for online shopping channel?

4. How does the company prioritize different factors as price, delivery time, goods quality?

5. What is online channel annual turnover? How much does it account for total turnover?

6. What are the advantages for your company to be outstanding in the online shopping market?

7. Do you believe your present business model is providing the results you hoped for? Is there anything you wish to improving regarding the business strategies?

8. Do you face competition of other online grocery stores? How do you value other companies' business strategies and tackle the competition?

9. What are the company's main challenges in the Norwegian online grocery market?

10. How do you think of online grocery shopping's future in Norway?

Appendix II: Overview of Norwegian E-grocery retailers

Grocer	Types	Pick up service fee	Pick up TW	Home Delivery Service Fee	Lead time	Time window
Joker	Multi-channel	Purchase over 1000NOK, free pick up; under 1000NOK, 49NOK for pick-up	2hours	Purchase over 1000NOK, HD costs from 69NOK; purchase under 1000NOK, HD costs from 89NOK. Purchase must be over 300 NOK for groceries to be delivered	6-23 hours	2 hours
MENY	Multi-channel	Pick up In store: Purchase over 1000NOK, free pick up; under 1000NOK, 49NOK for pick-up Pick up from Deli de Luca/Esso-stations , from 0NOK	2hours	Purchase over 1000NOK, HD costs from 59NOK; Purchase under 1000NOK, HD costs from 89NOK. Purchase must be over 300 NOK for groceries to be delivered	6-23 hours	2 hours
SPAR	Multi-channel	Purchase over 1000NOK, free pick up; under 1000NOK, 49NOK for pick-up	2hours	Purchase over 1000NOK, Home delivery cost from 69NOK; Purchase under 1000NOK, home delivery cost from 89NOK. Purchase must be over 300 NOK for	6-23 hours	2 hours
Kolonial.no	Pure online	Click and pick orders get 3% discount. For orders over 400NOK, free pick up. For orders under 400NOK, service cost is 39NOK.	7,5 hours	The price for home delivery variates: Scheduled delivering, price from 0NOK to 59NOK. Delivering at the same day when order is placed, price from 129NOK to 149 NOK. Express delivering within 90 minutes, price is 199NOK.	90 minutes- 5,5 hours	90 min to 6 hours
Adams Matkasse	Pure online			Free	96 hours	6 hours
Godtlevert	Pure online			Free	96 hours	6 hours

Appendix III: Questionnaire used for small-scale survey

Among the following factors, which are the most important 5 for you when choosing to buy grocery for each alternatives? please allocate 100 % to the selected 5 factors you choose above, with repect to their importance to you:

	Alternative 1: In store		Alternative 2: Home Delivery		Alternative 3: Click and Pick	
	Tick with x	Score	Tick with x	Score	Tick with x	Score
1. Product price (NOK): How much the cost of grocery products differs from the stores.						
2. Product range (%): The percentage of available grocery online with respect to the						
3. Service cost (NOK): The extra cost for order preparing and (or) delivery fee.						
4. Travel time (minutes): The time spend to reach the store and(or) pick up point for dedicated grocery shopping trip.						
5. Product quality (days): The number of days before the best of the date.						
6. Shopping time (minutes): The time needed to perform a grocery shopping in store or						
7. Store opening hours (hours): The amount of business hours of a grocery store.						
8. Time window (minutes): The range of Expected Time of Arrival.						
9. Lead time (hours): The time between placing orders and the orders can be delivered.						
10. Discount promotion(No.): The number of E-grocery discount ads received per week differs from in store ads.						
online.						
12. On time delivery (%): The rate of receiving the order within the expected time						
13. Delivery accuracy (%): The rate of receiving correct products with right amount.						
Total		**0**		**0**		**0**

Appendix IV: Stated preference questionnaire

QUESTIONNAIRE A1

Høgskolen i Molde
Vitenskapelig høgskole i logistikk

Please fill the answer into the grey cell in all 9 sheets

1) Have you ever purchased goods online? (Amazon, travels, flight tickets…)
1: Yes
2: No

2) Are you aware of the the possibility of buying groceries online at where you live?
1: Yes
2: No

3) Have you ever considered buying groceries online?
1: Yes
2: No

4) Have you ever purchased grocery online
1: Yes
2: No

5) Do you have a private vehicle available?
1: Yes
2: No

6) Where do you usually shop for your groceries?
1: Convenience stores(7/11, Narvesen)
2: Supermarket(Spar, Meny, Coop Mega)
3: Hypermarket(Coop OBS)
4: Low price stores(Kiwi, Bunnpris, Rema1000, Extra)

7) Which transportation mode do you usually use for shopping?

1: Private car
2: Public transport
3: On foot
4: Other _____

[ ] 8) Do you usually perform dedicated trips to do the shopping?
1: Yes
2: No

9) How long does it take you to reach your shopping place(round trip)?
[ ] minutes

10) How much would you be willing to pay to avoid this trip?
[ ] NOK

11) How many times do you buy groceries in each of the following ways (per week)?

	# times
In store	
Home delivery	
Click and pick	

12) How much on average do you spend on groceries per purchase?
[ ] NOK

[ ] 13) On what days do you usually do grocery shopping?
1: Monday-Friday
2: Saturday

14) If you purchase grocery online, how long are you willing to wait for your groceries?
[ ] Hours

15) What is your acceptable delivery time window if you purchase grocery online?
[ ] Hours

☐ **16) What is the average number of shopping bags for your grocery purchase?**

1: 1
2: 2
3: 3
4: 4
5: More than 4

17) Which are the categories of products you are most likely to buy in your typical shopping?

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

Stated preferences

Remember that your typical expense has the following characteristics:

Average cost of	0	NOK,
carried out in one day		
in the time slot		
using	0	**minutes** to reach the supermarket
and you declared that you would pay	0	**NOK** to avoid the trip.

Imagine, in the future, there are following scenario with the 3 options with 6 factors

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

Please use "x" to choose your answer in the box

Which one will you choose?			*
If you choose IN STORE, when you choose it, did you consider HOME DELIVERY and/or CLICK AND PICK?			
*What do you prefer between HOME DELIVERY and CLICK AND PICK?			

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

17) How many times would you buy groceries in one of the following ways (per week)?

	# times
In store	
Home delivery	
Click and pick	

[ ] **18) Should scientific reports demonstrate shopping groceries online reduces CO2 emissions, would you be willing to do so?**
1: Yes
2: No

Socio-demographic and attitudinal variables

☐ A) Gender
1: Female
2: Male

☐ B) Age
1: 16-24
2: 25-34
3: 35-44
4: 45-54

☐ C) How many family members do you live with?
0: Nobody
1: 1
2: 2
3: 3
4: More than 3

☐ D) Are you the one usually shopping for groceries in the household?
1: Yes
2: No

☐ E) What is your household monthly income range (after tax)?
1: Less than 7500 NOK
2: 7500-21000 NOK
3: 21000-34500 NOK
4: 34500-48000 NOK
5: 48000-61500 NOK
6: 61500-75000 NOK
7: More than 75000 NOK

F) Would you mind to leave us your e-mail address to expand the database and for further information?

_____

Appendix V: Overview of E-grocery market share

	IN STORE			HOME DELIVERY					CLICK AND PICK					P(i)		
	PP(NOK)	TT(MIN)	PR(%)	PP(NOK)	SC_HD(NOK)	TW(MIN)	PR(%)	LT(HOUR)	PP(NOK)	SC_CP(NOK)	TT(MIN)	PR(%)	LT(HOUR)	STORE	HD	CP
Large basket	1000	20	100	1000	59	120	100	12	1000	0	20	100	12	71,1 %	12,8 %	16,1 %
Small basket	500	20	100	500	89	120	100	12	500	49	20	100	12	83,2 %	8,7 %	8,0 %
Scheduled delivery	1000	20	100	1000	39	120	90	12	970	0	10	90	12	61,8 %	15,0 %	23,2 %
Express delivery	1000	20	100	1000	299	30	90	1	970	0	10	90	12	72,3 %	0,5 %	27,1 %

Glossary

Alternative: Generally, alternative means one of two or more available possibilities. In the this stated preference choice experiment study, the alternatives are the grocery shopping modes.

Attribute: Attribute refers to the quality or feature regarded as a characteristic or inherent part of something. In this study, attributes are associated with the three grocery shopping alternatives, namely in store, home delivery and click and pick.

Factorial: Factorial means the product of an integer and all the integers below it. For example, factorial four (4!) is equal to 4×3×2×1

Nordic countries: Nordic countries are the geographical areas that include Norway, Sweden, Finland, Denmark and Iceland.

Orthogonality: Orthogonality is the statistical property when variates are statistically independent. For example, two elements a and b of a vector space are orthogonal if their inner product is zero.

Omni-channel: Omni-channel and multi-channel are used interchangeably in this study. The term refers to a type of retail which integrates different modes of shopping. For instance, physical store, online, and telephone shopping.

Panel data: Panel data is also called longitudinal data. The term refers to a multi-dimensional data that is derived from cross-sectional units over time.

Pivot: Pivot means the central point on which a mechanism turns or oscillates. In the choice experiment, a pivoted attribute means the attribute value is depending on the stated value.

Sociodemographic: The term refers to a group characterized by a combination of sociological and demographical features. Typical sociodemographic groups are age, gender, religion, income, education.